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APRIL, 1920

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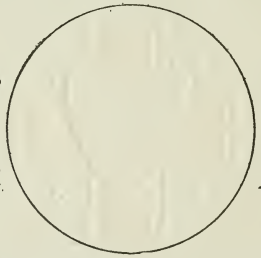

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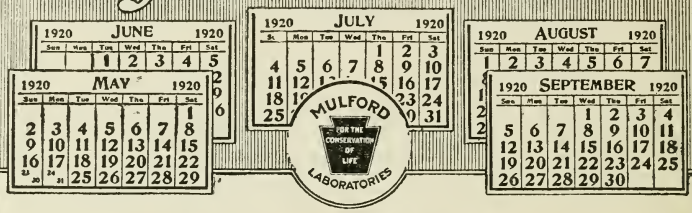

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CLINICAL THERMOMETERS

GOOD AND BAD

In line with the arguments which we have advanced on the subject of Clinical Thermometers, in recent issues of this paper, its readers will be interested in the following EXCERPT FROM THE BOSTON TRANSCRIPT of January 23, 1920:

The Clinical and Its Functions

"The clinical thermometer is a very delicate instrument, the use of which is largely restricted to those who have been trained in medicine or nursing. The value of the instrument depends entirely upon its ability (1) to indicate accurately the temperature of the human body; (2) to repeat the same temperature reading under the same conditions; and (3) to hold or 'register' the maximum point until such time as the practitioner wishes to reset it for another observation.

"The accuracy of the thermometer depends upon the purity of the mercury used, the absence of air specks, and the finest possible adjustment of the constriction, or trap, whose working is microscopic and which is the essential factor in making the thermometer 'self-registering.'

"In regard to the importance of securing exact and accurate readings from the clinical thermometer, it seems scarcely necessary to expatiate. The records which it provides are an important matter to the physician in modern medical practice, both in determining his diagnosis and in following and controlling the course of a disease through all its later stages. In using a clinical thermometer it is necessary always to shake the mercury down below normal before setting it for another reading. Thermometers of poor quality may shake down very easily, but many of them shake down so easily that they do not register the maximum temperature. This is perhaps the worst fault the clinical thermometer can have, and it is particularly dangerous when used on patients suffering from tuberculosis, pneumonia or appendicitis."

Determining Upon Its Accuracy

"The problem of deciding whether a clinical thermometer is accurate—whether it is an instrument of error or a guide to truth—is very difficult. No simple testing by the eye will give any sufficient indication, as it will in the case of a watch, which can be fairly closely tested by any observer merely by comparison with a chronometer."

"In large part even the profession has had to rely upon inadequate means of establishing the quality of the clinical thermometers offered for sale, while the general public has been almost wholly at the mercy of chance in the premises."

"To test a clinical thermometer requires special apparatus and standards which have been certified by a Bureau of Standards."

How the Massachusetts Law Is Working Out

Since the law went into effect in Massachusetts, governing the standardization and sale of Clinical Thermometers (General Acts of 1917) the Commissioner of Weights and Measures has been very active in testing Thermometers with reference to their value as measurers of temperature in the human body.

"Those instruments were passed which showed that they were practically safe under any condition of service. Those which were open to serious question or were proved to be dangerous were rejected and held for further observation."

"The first tests were harrowing, and fully justified the enactment and enforcement of the law. Quantities of thermometers were picked up in which three out of four, or seventy-five per cent, were rejected, while the general average covering the testing of nearly 10,000 thermometers has shown a rejection of one out of four —or twenty-five per cent. Later tests made after the law had been in operation for some time show a decidedly improved condition."

"Those manufacturers who proved to be making and selling reliable thermometers were given a license to certify and seal them in their own laboratories. This seal: the printed abbreviation 'Mass.,' with the manufacturer's designating mark, must appear on any clinical thermometer offered for sale in the Commonwealth of Massachusetts. The penalty for offering for sale unsealed thermometers is a fine of fifty dollars for each thermometer thus exposed. The man with the goods on hand is the man whom the law holds liable."

"By this means, the public is protected, as each thermometer is supplied with a certificate of accuracy bearing the maker's name. If the thermometer proves to be not up to the State standard, the certificate becomes evidence of malicious fraud and for this reason the manufacturer's certificate should be carefully preserved even though the corrections noted have been memorized."

"In testing, it developed that hundreds of so-called certificates had been issued which, aside from the certificate number, bore no relation whatever to the accompanying thermometer, but falsely claimed to represent verifications never made. And very rarely did they bear the manufacturer's name."

"The results obtained after a year of earnest effort in testing thermometers and inspecting manufacturing plants are sufficient proof of the efficiency of the department and the value of the laws. With the ever widening circle of the users of clinical thermometers, there will be an increasing appreciation of what has been done in Massachusetts and it is to be hoped a determined movement on the part of other States to measure up to the level of industrial honesty established here in this matter."

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THE
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VOL. XLVI APRIL, 1920 NUMBER 4

ORIGINAL ARTICLES

Authors alone are responsible for the opinions expressed in their contributions

AN ANALYSIS OF 19,639 EARLY TREATMENTS FOR THE PREVENTION OF VENEREAL DISEASES AND OF 653 VENEREAL INFECTIONS OCCURRING AMONG THE U. S. NAVAL FORCE OF THE ASIATIC STATION

BY CAPTAIN C. E. RIGGS
Medical Corps, United States Navy

THE data included in the following statistics were collected among the personnel of our naval vessels cruising in the Far East and also from the naval shore stations in that part of the world, excepting Guam. The territory covered is extensive. It extends almost as far south as Australia; it includes the Philippine Islands, Japan, the China coast, and some of our gunboats penetrated hundreds of miles into the interior of China by way of the Yangtze River.

The collecting of statistics in such a vast expanse of territory means that the work must be performed under a wide variety of conditions. This may be considered as detracting somewhat from the value of the conclusions which the compiled figures seem to indicate. The work was done by more than forty medical officers, most of whom were particularly careful and conscientious in making their reports. The period of time covered is something less than a year, including parts of 1917 and 1918. At least 90 per cent of the statistics were collected at the following places: Manila and Olongapo in the Philippines; Nagasaki, Kobe and Yokohama in Japan; Hong Kong, Shanghai, and Vladivostok on the China coast; and Peking and the Yangtze River towns in the interior of China.

There is one important factor concerning the venereal situation presented here which makes it very different from those other situations with which we have become acquainted since the social hygiene movement has come to the fore. It is that all these people to whose evil influences our men were exposed were oriental or semi-oriental. The ethical viewpoint of the East on all subjects differs from our own, and

the subject of sex morality forms no exception. Also, what are considered by some as allied factors for the spread of venereal diseases, such as the unrestricted sale of alcoholic drinks, poor economic and other social conditions, are in marked contrast to those met with in western countries, at least, in the United States. Because the ethical viewpoint of the East is different from that of the West does not necessarily mean that her morality in a given instance is inferior to our own. For example would anyone acquainted with the commercial honesty of the Chinese feel that their honesty is any less worthy than that which prevails throughout western civilization?

When it is desired to collect veneral statistics from various localities it is first necessary to prepare a proper blank form. This form should serve two useful purposes. In the first place, the figures and answers to questions on the form should give a mental picture of the venereal situation at the place concerned, and, also, the field work in collecting the data with the first hand information which it affords should stimulate efforts to obtain further improvement. A proper blank form is of the first importance. If the requirements of the form are captious or too exacting, it will defeat its own purposes. The form should be simple, and the questions and required figures should assist in pointing the way for further preventive activities.

In the preparation of the blank form which was used to collect the statistics under analysis here I was fortunate in having the advice and assistance of Commander W. A. Angwin, M. C., U. S. Navy, who had had considerable experience in collecting and analyzing venereal statistics. Tables 1 and 2 are actual instances of the use of this form.

In comparing Tables 1 and 2, it should be noted that the receiving ship at Cavite is practically a shore station and the *Brooklyn* a cruising ship. It is generally considered easier to control and prevent venereal disease among the personnel of a shore station than it is in the case of a vessel which cruises about from port to port. Of course the figures from any ship or station, if properly analyzed, should reflect rather faithfully the amount of attention the medical officer of that place gives to preventive work among his personnel.

At Cavite there were 15 infections for 325 men, which gives an annual rater per 1,000 of 553 and the annual rate for the *Brooklyn* was 419 per 1,000. Both ship and station claim that some of these infections were contracted at other places. To make further comparisons, one-half of the preventive treatments of the *Brooklyn* was administered before the third hour subsequent to exposure to the risk of infection, and for the shore station one-half was not given till the beginning of the seventh hour after exposure. While it is known that prophylactic

TABLE 1.—*Monthly Report on Prophylaxis and Venereal Diseases U. S. Receiving Ship at Cavite, P. I., for the Month of January,* 1918

From: Medical Officer.
To: Commanding Officer.
Subject: Monthly Report Prophylaxis.

Av. comp.	No. liberties	No. treatments	No. infected after prophylaxis			No. infected without prophylaxis		
			Gon.	Chan.	Syph.	Gon.	Chan.	Syph.
325	2,110	321	1	1	0	7	5	1

Number of prophylactic treatments according to hour and number of failures for each hour

No. hours after first exposure	No. of treatments	Gon.	Chan.	Syph.	No. hours after first exposure	No. of treatments	Gon.	Chan.	Syph.
1	12	.....	.....	.....	11	11	.....	.....	.....
2	11	.....	.....	.....	12	42	.....	.....	.....
3	48	.....	.....	.....	13	18	.....	.....	.....
4	12	.....	.....	.....	14	4	.....	.....	.....
5	31	.....	.....	.....	15	11	.....	.....	.....
6	44	.....	.....	.....	over 15	2	.....	.....	.....
7	18	.....	.....	.....					
8	16	.....	.....	.....					
9	21	1	.....	.....					
10	20	.....	1	.....					

Is *yes* or *no* concerning exposure required from men returning from liberty? No.
Is punishment given for failure to take prophylaxis? No.
Are venereal inspections held at suitable intervals? Yes.
Number, if any, previously reported as chanroid here as syphilis? None.

TABLE 2.—*Monthly Report on Prophylaxis and Venereal Dieases, U. S. S. Brooklyn, for Month of December,* 1917

From: Medical Officer.
To: Commanding Officer.
Subject: Monthly Report Prophylaxis.

Av. comp.	No. liberties	No. treatments	No. infected after prophylaxis			No. infected without prophylaxis		
			Gon.	Chan.	Syph.	Gon.	Chan.	Syph.
630	4,300	708	8	9	1	0	2	2

Number of treatments according to hours and number of failures for each hour.

No. hours after first exposure	No. of treat-ments	Gon.	Chan.	Syph.	No. hours after first exposure	No. of treat-ments	Gon.	Chan.	Syph.
1	75	.....	.....	.....	11	3	.....	1	.....
2	196	1	.....	.....	12	16	.....	.....	.....
3	180	2	2	.....	13	.....	.....	.....	1
4	117	3	1	.....	14	6	.....	.....	.....
5	48	1	1	.....	15	.....	.....	.....	.....
6	27	1	2	.....	17	1	.....	1	.....
7	16	.....	1	.....					
8	14	.....	.....	.....					
9	4	.....	.....	.....					
10	5	.....	.....	.....					

Is *yes* or *no* concerning exposure required from men returning from liberty? Yes.
Is punishment given for failure to take prophylaxis? Yes.
Are venereal inspections held at suitable intervals? Yes.
Number, if any, previously reported as chancroid here as syphilis? One.

treatments have their greatest efficiency if administered during the first, second or third hours, yet in the above instances Cavite had two infections following 321 treatments, and the *Brooklyn* 18 following 707 treatments, or 0.62 and 2.54 per cent, respectively.

To explain this unexpected result it is only necessary to look at the interrogatories at the bottom of the tables. There it is seen that the ship punishes for failure to take early treatment and the shore station does not. It is obvious that the 18 infections recorded as taking place in spite of prophylaxis are mostly errors due to misstatements made by those concerned for the purpose of avoiding the assigned punishment.

At places where punishments are given the men who, having exposed themselves to the risk of infection, deliberately fail to take advantage of early treatment, there is considerable difficulty in keeping a reliable record. In the case of young men who become infected, I think it is nearly always possible for the medical officer to obtain the truth by means of a confidential talk. It is different with older men, who are more sophisticated to service conditions. Such men seem to believe that, once having told a lie, it pays to stick to it.

If a medical officer has the time and inclination, he can see to it that his venereal prophylactic reports are truthful representations of the venereal situation within his command. He can also keep the preventive propaganda well before the members of his crew. Usually the best results are found in small units having an earnest, active medical officer. It seems that any man who has just acquired a venereal

disease is entitled to an unrestricted confidential talk with his medical officer. Such men are nearly always very repentant and have a "never again" attitude which it is desirable to take advantage of. During these talks their unfounded fears can be quieted and their resolves strengthened. They are then more impressionable, good listeners, and will retain a great deal of what they are told. They will probably impart some of this information to their associates and thus become useful factors in the spreading of preventive propaganda.

For these reasons, the best reports in venereal prevention are found to come from small gunboats where the medical officers have the time to give considerable personal attention to preventive work. This is shown by taking the total of the smallest units of the station and comparing them with similar figures for the remainder of the fleet. There were six small units on the station having a total average complement of 264 in which the number of men in each unit was not less than 15 nor more than 66.

The totals for the small units and for the remainder of the force are as follows:

TABLE 3.—*Giving Comparative Data for Small and Large Units*

Av. com.	Liberties	Treatments	After prophylaxis			Without prophylaxis		
			Gon.	Chan.	Syph.	Gon.	Chan.	Syph.
2,315	93,361	13,303	164	178	16	70	59	14
264	18,000	2,517	20	15	1	1	0	0

The following interesting comparisons are made from the above table:

	Large units	*Small units*
Per cent of crews infected	21.64	14.01
Per cent of failures in treatment	2.69	1.43
Average number of liberties for each infection	186	486
Average number of treatments per man	5.7	9.0
Average number of liberties for each treatment	7.0	7.1
Average number of liberties for each gonorrheal infection	398	857
Average number of liberties for each chancroidal infection	393	1,200
Average number of liberties for each syphilis infection	3,112	18,000
Average number of liberties per man	40	68

Most of the above comparisons are favorable to the small units. An exception is that for the large units the number of prophylactic treatments is 5.7 per man, while for the smaller it is 9 per man, indicating a greater degree of libertinism on the part of the men of the small commands. However, when the number of liberties is compared to the

number of treatments there is practically no difference, each showing an equal rate of dissipation for the large and small groups. If the same rate of infection had obtained in the large units as did in the small, there would be 177 less infections for the seven months. Or, other things being equal, if the preventive measures of the small units had been applied in the large units there would have been an annual saving from infection of 302 men, and an unusually large proportion of these would have been saved from syphilis.

It is reasonable to suppose that the venereal class of diseases varies less in its proportional numbers than any other class of germ-borne diseases. Firstly, each of the three kinds of venereal diseases has the same direct method of transmissions, and indirect transmission is rare. Secondly, their infectivity and virulence vary less than is probably the case with any other class of diseases. Of a total of 123,023 venereal infections taken from the report of the Surgeon General of the Army for the year 1918 the percentages for each kind (disregarding decimals) were: gonorrhea, 76; chanroid, 5; and syphilis, 18.

These proportions are for the year of the World War and probably do not represent actual condition as well as those calculated from peace-time statistics. In fact, they represent a rather wide departure from other statistics. In the Navy, taking the ten years from 1909 to 1918 inclusive, the first five years have the diseases appearing in the proportional numbers 63, 20 and 16, respectively, and the second five years 61, 24, and 14, respectively. Again, in the Army, the period from 1912 to 1916 has the three diseases, gonorrhea, chancroid, and syphilis, appearing as 59, 19 and 21, respectively.

The proportion of each kind of venereal disease that may be expected to appear in a community, or what may be termed the normal proportion, is principally of interest when one attempts to estimate the good that has been accomplished through an intensive preventive campaign. For example, in one of the above instances the comparative rates of infection for gonorrhea, chancroid and syphilis are 76, 5 and 18, respectively, and in another they are 61, 24 and 14, respectively. In the latter instance there is an increase of 19 chancroidal infections which is compensated for by a reduction of 15 gonorrhea and 4 syphilis. Therefore, considering the relative gravity of the infections and that such change was due to the application of certain preventive measures, it should be considered that these measures had been productive of good.

There happen to be available the statistical records of two intensive campaigns for the suppression of venereal diseases which were carried out in the naval service. The relative rates of infection from these

two campaigns may be compared with similar rates of the entire Navy to determine if these campaigns have produced a favorable departure from the so-called normal relative rates. The results are as follows:

	Number of cases of—		
	Gonorrhea	Chancroid	Syphilis
Naval Training Station,[1] Norfolk, Va.	89	27	9
Asiatic Station (Table No. 4)	221	234	23
Totals	310	261	32
Relative proportion	51	43	5
Relative proportion for ten years in Navy	62	22	15
Differences	11	21	10

That is, in practically every 100 venereal infections of all kinds the preventive measures that were instituted resulted in substituting 21 chancroidal infections for 11 gonorrheal and 10 syphilitic. If this deduction be justified, it is obvious that this aspect of prevention alone, applied to the Navy as a whole, would result in an enormous saving of health.

The proportion in the prevalence of syphilis and gonorrhea is usually considered as 1 is to 5. Table 3 furnishes figures from which to ascertain these proportions under 3 different conditions of preventive work. Firstly, when no medical prophylactic treatment was applied; secondly, after prophylaxis; and, thirdly, after prophylaxis where there were opportunities for intensive preventive work. For the first condition the figures are 14 and 70, or the normal proportion of 1 to 5. For the second condition there are 164 gonorrhea and 16 syphilis or a proportion of about 1 to 10. And, for the third condition, the proportion of syphilis to gonorrhea is exactly 1 to 20.

It is probable that the two favorable changes were the results of the less thorough and the more thorough applications of so-called medical prophylaxis or early treatment. This branch of prevention was used throughout the station. Some medical officers placed a great deal of stress upon early treatment, while others supported it only in a perfunctory manner. There is available a record of 19,639 of these treatments in which the number of hours elapsing since exposure to the risk of infection is stated and, also, the number and kind of infection resulting from the exposure, in spite of the early treatments, are given for the corresponding hours. The records were made under such varying circumstances that a marked degree of accuracy cannot be

[1] Riggs: A study of Venereal Prophylaxis in the Navy. *Social Hygiene*, Vol. III, No. 3.

claimed for them. In particular, since punishment for failure to take prophylaxis was quite uniformly enforced, it may be assumed that there are some instances when prophylaxis was not used as alleged.

A compilation of these statistics is shown in the following table:

TABLE 4.—*Giving the Treatments, Failures and Percentage of failures for Each Hour after Exposure*

Hours subsequent to exposure	Number of treatments	Number followed by			Totals	Percentage of failures
		Gon.	Chan.	Syph.		
1	3,453	7	20	4	31	0.897
2	4,400	27	43	3	73	1.659
3	3,104	26	31	3	60	1.932
4	2,034	19	20	2	41	2.015
5	1,216	28	16	3	47	3.865
6	1,179	21	20	1	42	3.562
7	742	13	16	1	30	4.043
8	862	23	18	0	41	4.756
9	534	17	11	1	29	5.430
10	645	10	12	1	23	3.565
More than 10	1,470	30	27	4	61	4.149
Totals	19,639	221	234	23	478	2.433

Coincident with these infections there were 83 gonorrhea, 70 chancroid, 22 syphilis, occurring without prophylactic treatment.

This table is submitted with apologies, as no doubt it contains many errors that lessen the apparent efficiency of early treatments. However, there are some fundamental truths to be looked for. One is that, for a certain number of hours subsequent to exposure to the risk of infection, the earlier the treatments are administered the more effective they become. Another is that there are two periods where the efficiency of early treatments lessens markedly. These periods are between the first and second hours and between the fourth and fifth hours. Having observed a lessening of efficiency at the same periods in another table prepared in the same manner, I believe the occurrence cannot be considered accidental.

It is maintained by some that the employment of medical prophylaxis for the prevention of venereal diseases is wrong because it is an encouragement to incontinence. Edith Houghton Hooker,[2] in an analytical article, attacks the results of a study of venereal situation at the Naval Training Station, Norfolk, Va., arguing that the deductions from submitted figures concerning early treatments were incorrectly made. She states that no evidence is forthcoming as to the efficiency of arti-

[2] Hooker: A Criticism of Venereal Prophylaxis. *Social Hygiene*, Vol. IV, No. 2.

ficial prophylaxis in the mere fact of only 125 men contracting disease after prophylaxis while 333 contracted disease without it, because "no figures are given with regard to the proportional number of those who exposed themselves to the infection." This argument is, of course, correct. As a matter of fact there are no figures available of those who exposed themselves to the risk of infection and did not take prophylaxis, from which we may deduce the percentage of infections that might normally be expected when no artificial preventive means were resorted to. An attempt to collect such statistics would probably prove impracticable. However, it may be assumed that early treatments given as late as ten or more hours after exposure are without preventive effect. If this assumption be correct, then, knowing the number of resulting diseases, the calculated percentages in such cases would be the same as if no prophylaxis were used.

It would be an ideal method of determining the efficiency of medical prophylaxis if it were possible to compare the number of infections following a certain number of exposures with the number of infections following an equal number of exposures in which prophylaxis was used. As statistics without prophylaxis are wanting, it remains to determine the efficiency of early treatments by examining such tables as Table 4, of which there is a number in existence. All these tables tell the same story. It is that medical prophylaxis is a remarkably efficient branch of prevention, in particular, if used within one hour subsequent to exposure to the risk of infection.

The same critic does not spare from attack even the first hour, for she states, concerning such immediate treatment, that "it is scarcely to be supposed that in any considerable proportion of the cases men can extricate themselves from the embraces of their prostitutes and get back to the sanitary tent within one hour of actually having had intercourse."

It seems to me that this assumption is not warranted by such facts as we have. At least, in the prophylactic table in the article under criticism there is recorded that 1180 men stated that they returned for their treatments within one hour after exposure, and in the table presented here 3,453 out of 19,639 men also state that they did likewise.

It is recognized that the use of artificial prophylaxis is the least ideal of those preventive means which actually prevent. This is because, theoretically, it seems dangerous to instruct men in any subject as to how they may depart from the path of virtue and at the same time possibly avoid the penalty. The road to absolute continence for the sailor is a long one. Much of his leisure time is spent as a stranger in strange surroundings. He has limited financial resources, and,

consequently, is denied the comforts and better pleasures of the usual tourist. The following letter was received by me while the statistics presented here were being collected and is offered as an actual instance of the enlisted man's side of the case:

Dr. C. E. Riggs,
U. S. S. Brooklyn.
Dear Sir:

I am taking the liberty to write this personal letter with the hope that you will do what you can to have me relieved from duty on the Yangtze River.

In the first place I have found out that with a crew of this size there is practically nothing to do, and especially the kind of work I will in the future be required to know. After being on a job like my last one, where I had to work continually, I find it impossible to lead a life of inactivity. Second, there are many men who enjoy themselves by visiting and mingling with the natives. Others find themselves welcome in saloons and dives. Men in uniform are not wanted in any houses except "pig-shacks." There are no clubs in which an enlisted man may find welcome and, of course, saloons are not open to men who do not drink. To sum up the whole thing, there is absolutely no place for enjoyment ashore and nothing to do aboard ship. It is a waste of time to stay on duty like this. No doubt there are many men who would like this duty.

Hoping I am not taking too much of your valuable time, and thanking you most sincerely, I am,

Very respectfully,

This letter has in it much that is true and yet not the whole truth. The circumstances under which an enlisted man finds himself ashore in oriental cities are most unfavorable. As stated, public entertainments do not exist in the Orient, or, if so, only in a form which is of no interest to him. The language is so strange that he cannot hope to learn more than a word or two of it. There is practically no opportunity to make new friends. When he has seen the strange people, streets and customs, he has exhausted about all available legitimate entertainment. He is not admitted to the local foreign clubs, and he is never seen about hotels of the better class. If he becomes tired from sight-seeing and wishes to sit down for a rest, or to find shelter from a passing shower, or to warm himself, there is no respectable place open to him. However, there are two classes of places in the Far East where he may find these facilities and, besides, be assured of a warm welcome while his money holds out, and these are the saloons and bawdy-houses. Of course, the frequenting of these places is against the better natures of most enlisted men, but it is to be expected that in the end the force of circumstances will have had its way.

Of course, educational prophylaxis is the ultimate solution of the venereal disease problem. This branch of prevention was urged and used throughout the Asiatic Station. Each medical officer imparted

what information he thought was for the best, but there was probably considerable lack of uniformity in what was taught. We are, as yet, practically without means of estimating the good accomplished by preventive education as a whole, or any particular part of it, while, given a venereal prophylactic table, we can mathematically calculate from it the probable number and kind of diseases prevented. In regard to the statistics submitted here, the educational branch of prevention had its best try-out on board the small ships, and the incidences for the small and large units, according to Table 3, are 14.01 and 21.64 per cent, respectively. But early treatments were almost twice as efficient on the small as on the large ships—that is, the percentages of failures were 1.43 and 2.69, respectively. Apparently educational prophylaxis needs further study as to the good that may be accomplished by it, and, in particular, as to what should be taught and what should be omitted. It is also probable that many persons who are doing this teaching are unfitted to teach concerning sex matters, or, at most, unfitted to be given free latitude.

A METHOD FOR THE MUSEUM DISPLAY OF THE GROSS PATHOLOGY OF WAR WOUNDS

By Major JAMES F. COUPAL, M. C., U. S. A.
Army Medical Museum, Washington, D. C.

(With eleven illustrations)

THE advances in the knowledge and treatment of war wounds during the World War have been so great that the author, while preparing specimens for mounting at the Army Medical Museum, has evolved the following procedure:

The medico-military interest in gunshot wounds in this conflict centers around new types of ordnance and the gas infections which were less frequent in previous wars and were never adequately investigated. These two factors are the basis of the classifications which follow. Because of the inaccuracy of the knowledge obtained in battle of the missiles causing injury, a classification of wounds on the basis of the separate wound-producing types of ordnance has not been strictly adhered to. Even when the missile was known at the time of injury the evidence has been lost through the general practice of using the term G. S. W. on the diagnosis tags. A classification by missiles can be followed out only in so far as the agents produce lesions peculiar to themselves, or where the missile is recovered from the tissues. Machine-gun and rifle wounds are placed in group one; shrapnel, high explosive shell, grenades, and aerial bombs in group two; and trench dagger and bayonet in group three. "Shrapnel" was frequently noted on the diagnosis tags, but there were actually few shrapnel wounds, as this type of ordnance was practically never used by either belligerent on the western front after the entry of the United States into the war.

A further division, dependent on the rapidity of action of the infectious processes, is necessary. Infections of relatively badly traumatized wounds proceeded, as a rule, with extreme rapidity. Changes from the gas gangrene group of organisms begin four to six hours after injury where the damage to tissue or its blood supply is extensive enough and most of their characteristic lesions are produced before the end of ten days. From the fifth to the twentieth day the ordinary pyogenic bacteria replace the gas gangrene group and produce changes in the lesions peculiar to themselves. Taking the time element as a basis, the following subdivision can be made: (*a*) Those that produce death or necessitate amputation in the first forty-eight hours, (*b*) those that produce the same results in more than two and less than twenty days, and (*c*) those that run to a partial repair and a certain

degree of chronicity before they produce death or necessitate amputation. Class (*a*) comprise those cases that necessitate a speedy amputation because of rapidly progressing infection with the gas gangrene group and include cases with irreparable destruction of tissues. Class (*b*), the largest group, are practically all infected debrided wounds, most of the infections being with members of the gas gangrene group of organisms. These are by far the most interesting because of variations in the gross changes produced. Class (*c*) contains the later types where the ordinary pyogens have replaced the gas infections and the chronic infected wounds with sinuses and bone involvement result.

Technique of Preparation.—Specimens are washed for twenty-four hours to free them of the Kaiserling I or the 10 per cent formalin in which they are shipped, X-rayed, frozen and sectioned. The twenty-four-hour washing is necessary as the salts in the fixing solutions interfere with freezing. They are then frozen in a solid block of ice. Specimens showing much of the localized emphysema of gas gangrene freeze with difficulty as the changes in temperature cause a contraction and expansion of the imprisoned gases. This produces blow-holes in the ice blocks, which indicates that the muscle invaded by the gas is not frozen solid. If an attempt is made to saw the specimens in this condition, bone fragments or even heavy connective tissue fascias will be driven into the gas area by the saw, spoiling the most important part of the specimen. This occurs whenever the saw moves from a more resistant to a less resistant area in the tissue. The result is a shredding of fascias and rotation of bone fragments in the display surface of the specimen. It is therefore necessary to freeze thoroughly before sectioning.

The specimens are then sawed into serial sections from one-half to three-fourths of an inch in thickness in the longitudinal plane that, judging from the location of the injury and from the X-ray, will show the lesion to best advantage. These cuts include external sections showing the wounds of entrance and exit. A band or circular saw is best adapted for this work, but because of the frequent shell fragments an ordinary butcher's bone saw is safer for a beginner. A localization of the shell fragments by a two-plane X-ray is essential to avoid hitting the steel with the saw. This localization of the foreign bodies enables one to saw through the wound tract in such a plane that these bodies and any cloth fragments or other secondary missiles are properly displayed *in situ*.

Sections from the typical areas of gas gangrene and from the wound tracts are taken for microscopical examination. These are stained for bacteria by MacCallum's modification of Goodpasture's stain and

other routine methods. These only, of course, show the morphology of the infecting organism, which is not a very valuable differentiation in a group of some thirty rod-shaped bacteria which differ little in size and staining qualities.

The first group of specimens, those originally obtained less than forty-eight hours after injury, show colors very well if they are sent through the Kaiserling II and III immediately after they are cut. This is important, as in solid specimens like extremities the penetration of the Kaiserling I or formalin is not very deep, and most of the excellent colors found in specimens that have been in these fluids for as much as eight months will be lost by delay.

In the specimens of gas gangrene in extremities with sinuses or large wound tracts, some of the reds of the normal muscle have been darkened by the long formalin fixation, though in these the typical brick-red of the muscle invaded by the gangrene group seems to resist this action. This is especially well defined in the specimens that have not been debrided extensively and where the lesion is being produced by a single member of the gas gangrene group. Multiple infections, especially where the putrifiers were a factor, always darken these reds.

The very early wounds without debridement give the best specimens from the standpoint of color and the demarcation of the pathological lesions. These usually show in the case of high explosive wounds a piece of uniform carried into the tissues in front of the missile, with frayed pieces stretching out behind in the wound tract like the tail of a comet.

Since practically all of these specimens were obtained by the writer while on duty with Evacuation Hospital No. 6 during the rush of work received from the Battle of the Argonne, the clinical histories are very meager. The cases came in bearing diagnosis tags which usually read as follows: Pvt. John Doe, Co. C, 100 Inf. G.S.W. Rt. Leg., A.T.S. tagged at 8 p.m., Oct. 22, 1918. Then in the stress of work in the operating rooms this data was very difficult to obtain for the autopsy records, and practically impossible where no autopsy was done, because of the speed of evacuation.

As much of the clinical data as could be obtained is given. A complete description of the gross and microscopical findings is made in each case. The gross description can be made very complete, as the pathological lesions are exactly defined in the serial sections and can be reconstructed from them. All of this information is filed with the protocol together with X-rays, microscopical slides, etc. In addition a lengthy label is printed on the museum jar by a method devised by Capt. Charles F. Silvester, the present Museum Preparator. Some

of these labels contain a caption and twenty to twenty-five words. In addition, this method lends itself readily to local labeling, and certain localized lesions are brought quickly to the eye. An abstract of this data is contained in a folder attached to the museum case.

High explosive wounds of the tibia are especially important because the comminution of this bone practically always damages the posterior tibial artery or its branches. A vicious circle is established when, in addition to the vessel injury, extravasation and exudation in this region, held in as it is by dense fascia, is transposed into pressure. This further interferes with the circulation, causing a circulatory sluggishness or even stasis, conditions ideal for the progress of a gaseous gangrene.

Frequently after only twenty-four hours gas is found 10 or 15 cm. from the wound tract and seems to be limited to muscle groups only in so far as the dense fascias are able to resist the progress of the infection. The microscopical sections show most of the edema confined to the space between the areas of Cohnheim and the sarcolemma. The collections of gas are found for the most part between the smaller bundles and spread along the muscle fasciculi. The intensifying of the muscle reds in the gross specimens wherever the infection is in comparative purity, and not due to the lower types of putrifiers, is noted in the stained sections. These brick-red areas of muscle take the eosin stain far stronger than the normal muscle and present the same general color scheme as the gross specimen.

CLASSIFICATION OF WAR WOUNDS

Group I.—Machine gun, rifle, and pistol bullets.

Class A. Wounds that cause death or amputation within forty-eight hours.

Class B. Wounds that cause death or amputation in more than two and less than twenty days.

Class C. Wounds that produce their lesions after the twentieth day.

Group II.—High explosive shell, grenade and aerial bombs, and shrapnel.

Class A. Wounds that cause death or amputation within forty-eight hours.

Class B. Wounds that cause death or amputation in more than two and less than twenty days.

Class C. Wounds that produce their lesions after the 20th day.

Group III.—Bayonet, and trench dagger wounds.

Class A. Immediately fatal wounds.

Class B. Wounds that kill subsequently or are recovered from.

Conclusions.—The special advantage of this method is a serial dis-

play in three dimensions of the lesions of war wounds that will guide surgical procedure as follows:

(*a*) A demonstration of the extent of damage in tissue due to the different types of missiles which will gage the debridement operation.

(*b*) The foreign bodies and bone fragments are shown in exact relation to the wound tract.

(*c*) The changes in muscle color due to gas gangrene are shown in such a way as to furnish surgeons the criteria to make the decision for or against amputation.

(*d*) The chronological changes of these conditions are shown in such a way as to give the greatest help in the after treatment and reconstruction of war wounds.

(*e*) The microscopical sections give the bacteriologist knowledge as to the avenues and extent of these infections.

Accession No. 4707.

DESCRIPTION OF FIGS. 1, 2, AND 3, GROUP II, CLASS A

Clinical Brief.—This man was hit by a high explosive shell about 8.30 p. m., October 27, 1918, came into Evacuation Hospital No. 6 at 4 a. m. with a diagnosis of G. S. W. right thigh. He was wearing a very tight tourniquet and showed some signs of shock. He was operated after two hours in the shock room at 6 a. m. about twelve hours after the injury.

Gross Description.—Specimen consists of the right knee from the middle of the thigh to the middle of the lower leg. There is a compound comminuted fracture of the femur in the lower, and of the tibia in the upper third. There is a cotton cloth tourniquet just below the line of amputation. The femoral artery and vein are severed at the line of fracture of the femur. A vertical section in the antero-posterior plane shows a piece of shell casing 1×2×5 cm. just under the skin over the patella.

The head of the soleus for 5 cm. downward shows extensive gas gangrene, the muscle tissue showing a marked piting.

Diagnosis: High Explosive Wound. Fracture C.C. of femur and tibia, right, with gas gangrene.

DESCRIPTION OF FIG. 4, GROUP I, CLASS B

THROUGH AND THROUGH M. G. BULLET WOUND, LEFT THIGH, WITH C.C. FRACTURE OF FEMUR AND GAS INFECTION.

Clinical History.—This is an amputation of a thigh, debrided forty-eight hours after a through-and-through machine-gun bullet wound. The amputation was done for gas gangrene three days after the debridement.

Gross Description.—Specimen consists of left thigh amputated at its middle third, with the lower leg cut away 8 cm. below patella. There is a debrided wound of entrance on the inner aspect of the posterior surface of the thigh 4 cm. in diameter, 10 cm. above the internal condyle and 4 cm. internal to the midline. There is a debrided wound of exit 6 cm. in diameter on the outer aspect of the anterior surface of the thigh 6 cm. higher than the wound of entrance. Both wounds are lined by a greyish-green exudate, and bony fragments can be seen in the anterior wound.

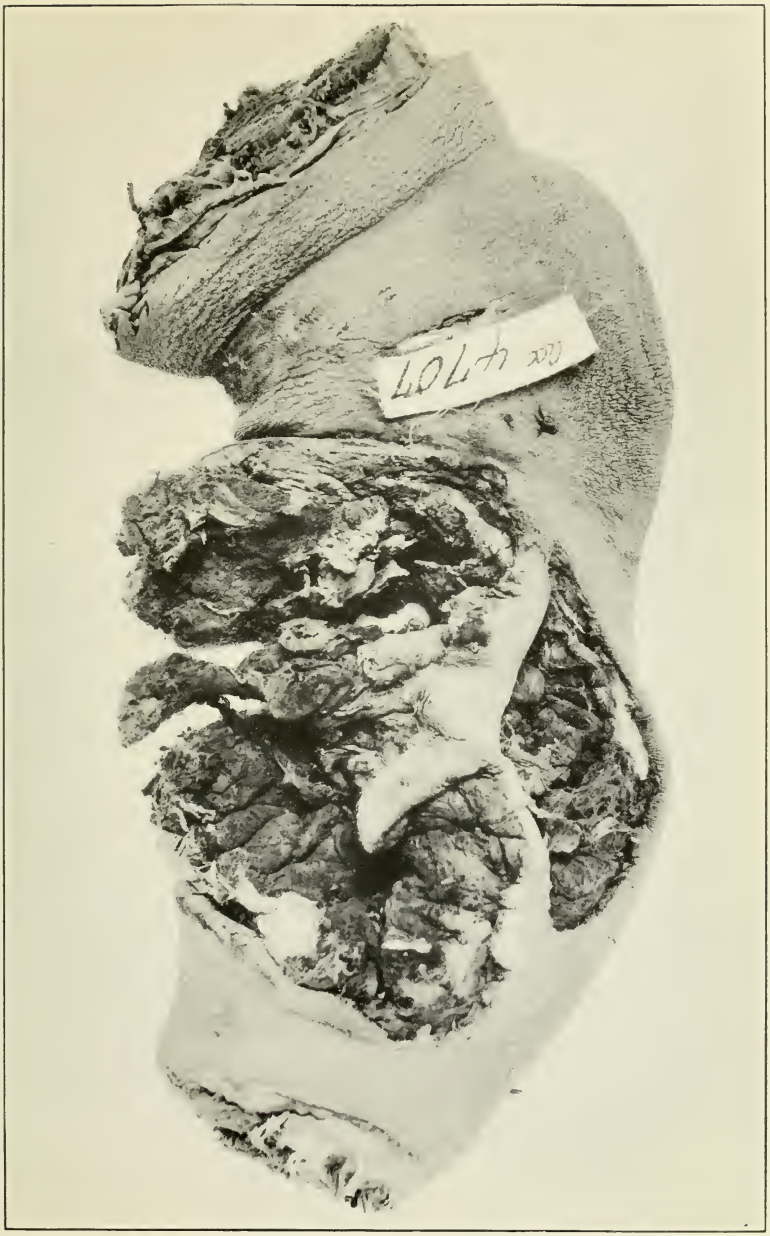

Fig. 1—Group 2—Class A.—Wound on outer surface of right thigh produced by contact explosion of a 37-mm. shell. Amputated twelve hours after injury without removing tourniquet.

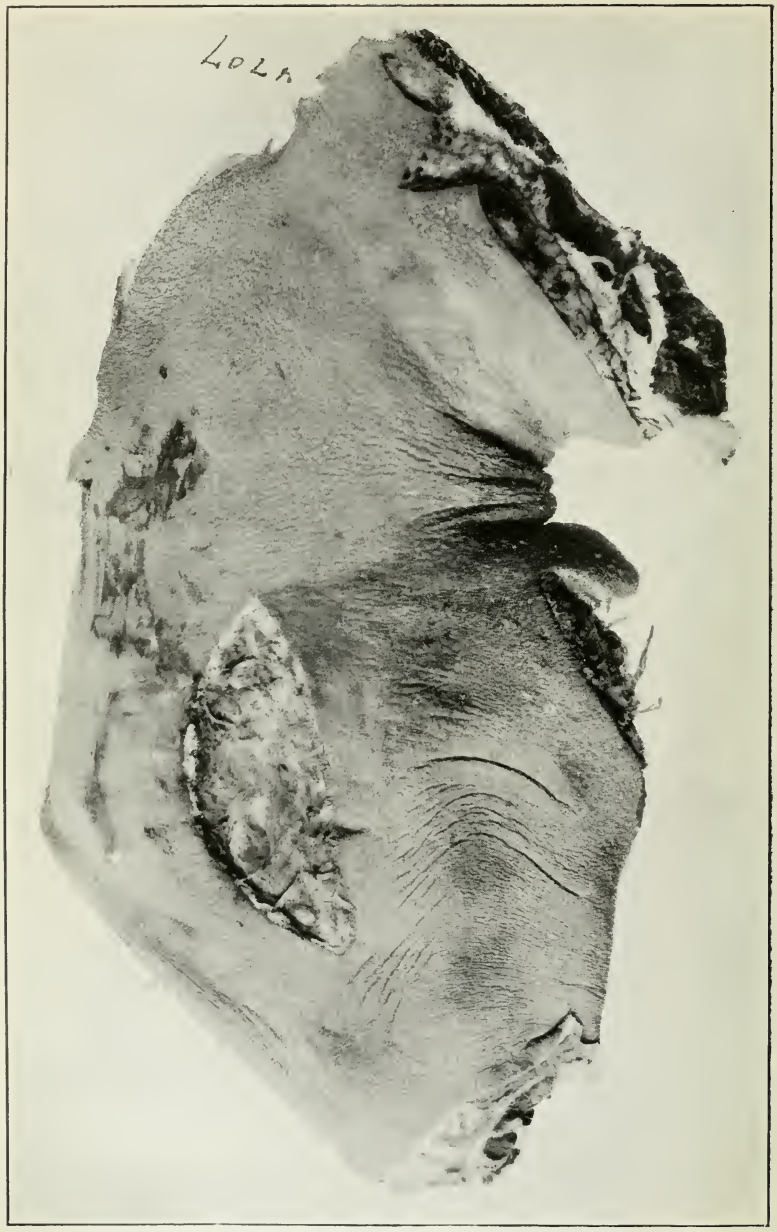

Fig. 2—Group 2—Class A.—Inner surface of right thigh showing wound of compounding produced by the proximal fragment of the femur.

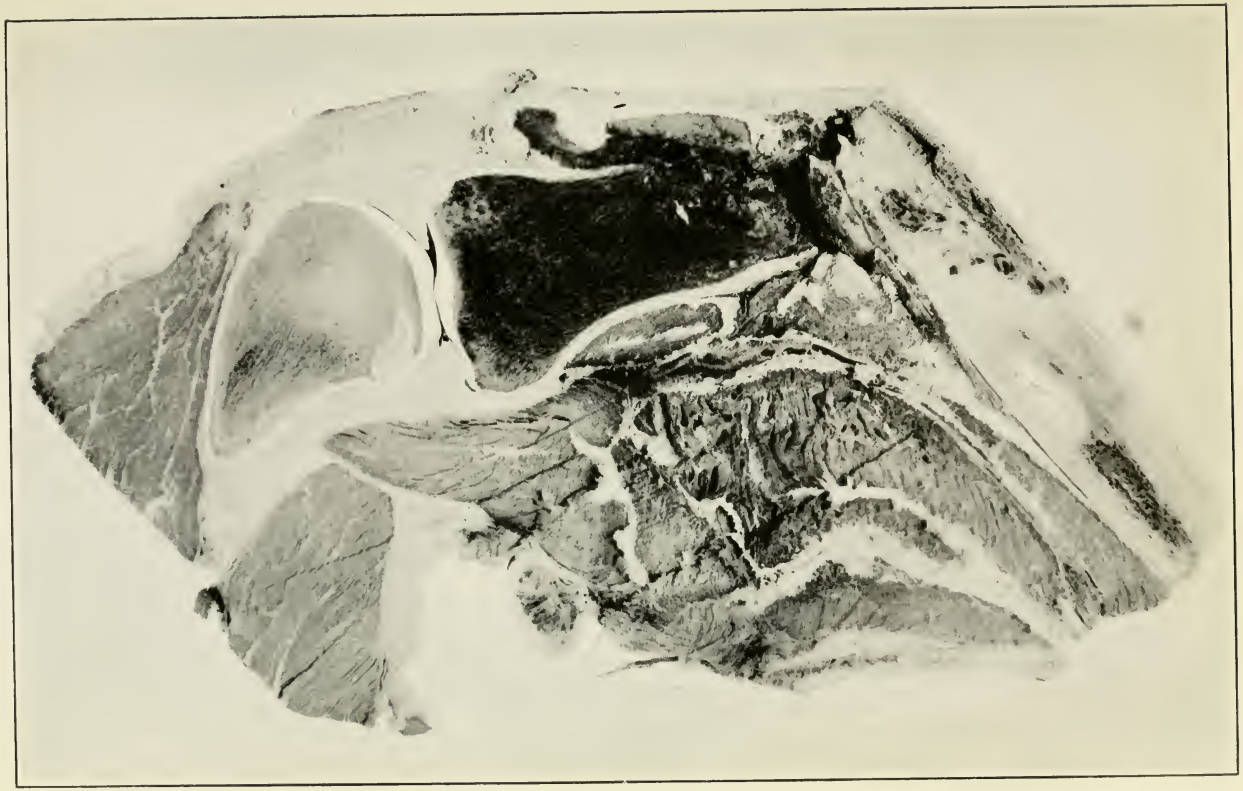

Fig. 3—Group 2—Class A.—Mid-section of right thigh to show a compound fracture of the lower third of the femur with comminution and a gas gangrene of the biceps. There is a hemorrhagic inflammation of the bone marrow.

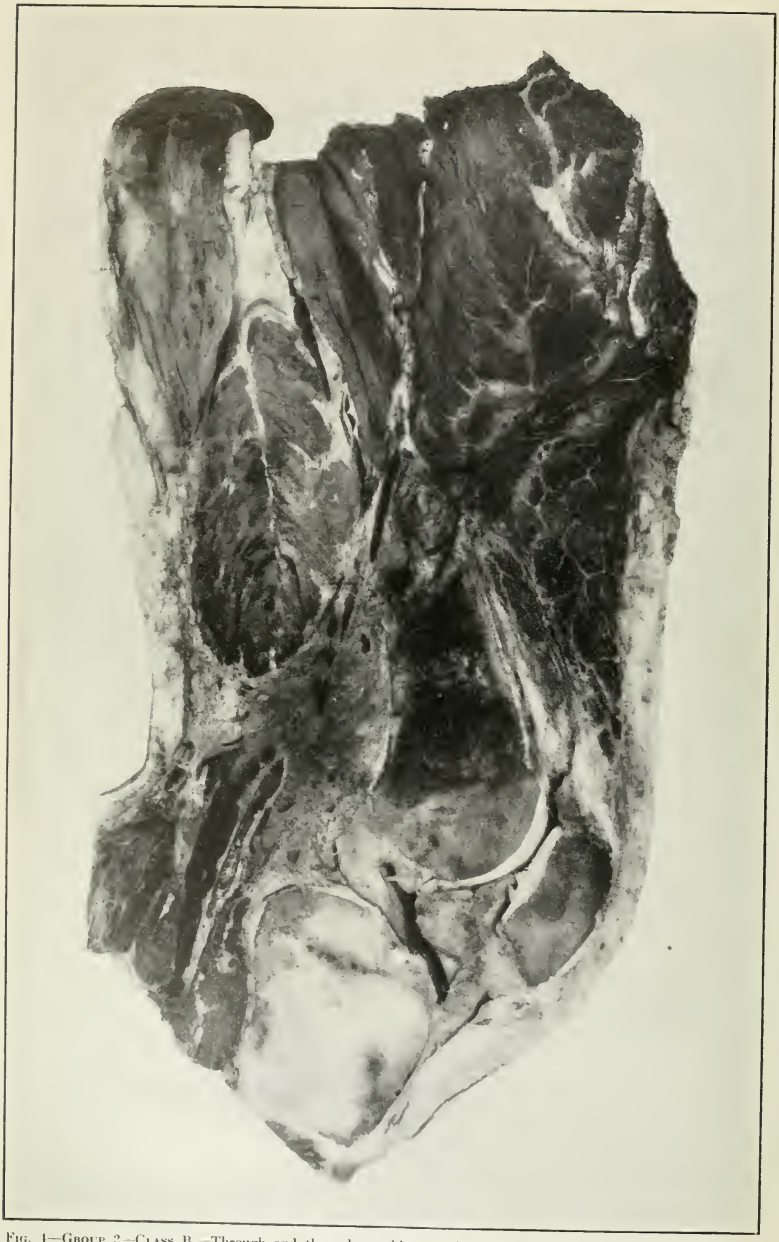

FIG. 4—GROUP 2—CLASS B.—Through and through machine-gun bullet wound with marked emphysematous gangrene of the biceps muscle, a comminuted fracture of the femur and a debrided wound tract infected with the putrefactive bacteria.

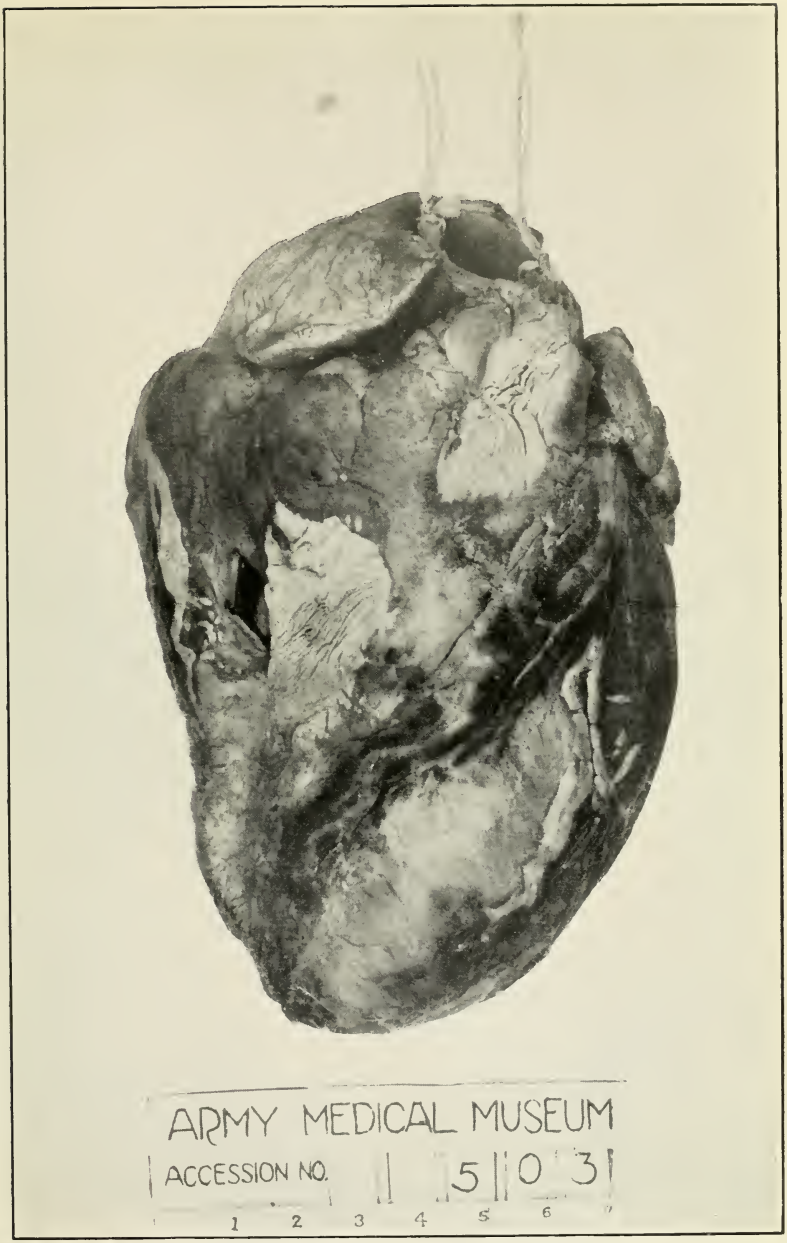

Fig. 5—Group 3—Class A.—Dagger wound of right ventricle.

Fig. 6—Group 2—Class B.—High explosive shell wound of left leg with a comminuted fracture of the lower third of the tibia and the edematous type of gas gangrene.

Fig. 7—Group 2—Class B (same as Fig. 6).—High explosive shell wound of left leg showing gas gangrene, a comminuted fracture of the fibula and a piece of high explosive shell opposite the lower end of the proximal fragment of the fibula.

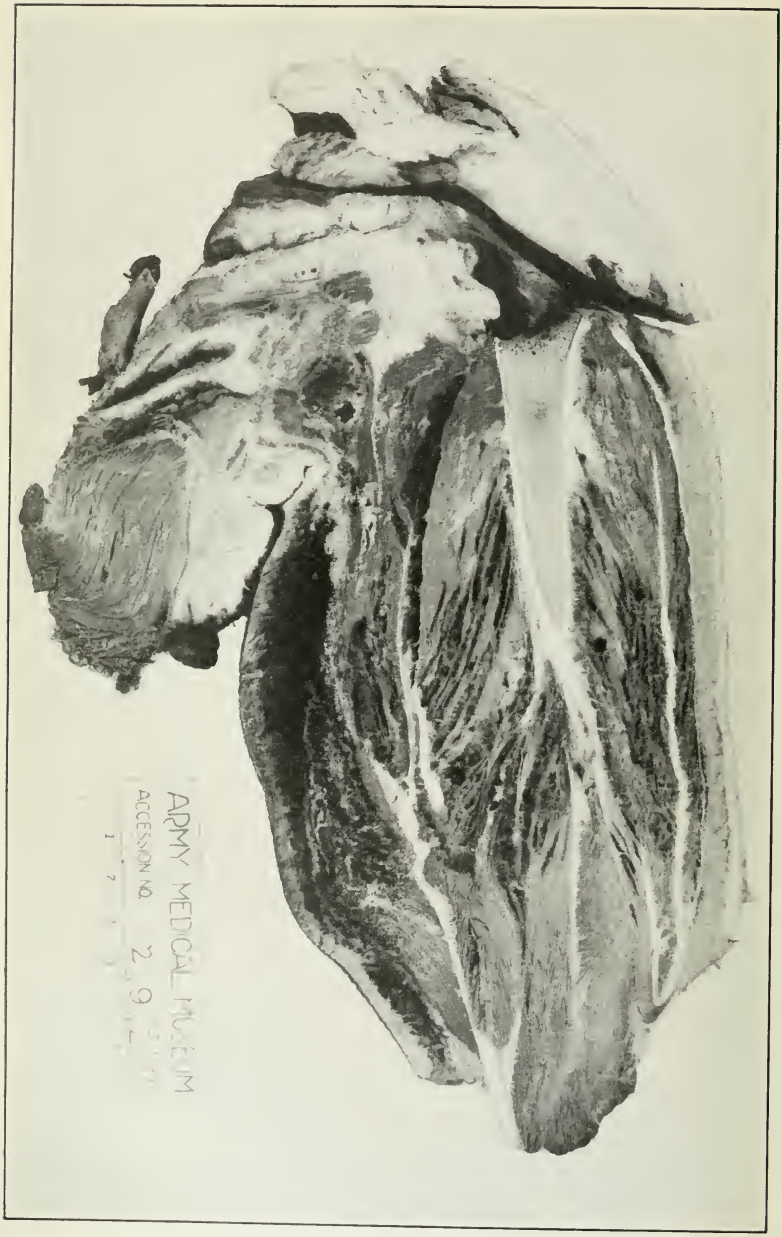

Fig. 8—Group 2—Class B.—High explosive shell wound of the left knee showing the extreme type of emphysema due to gas gangrene.

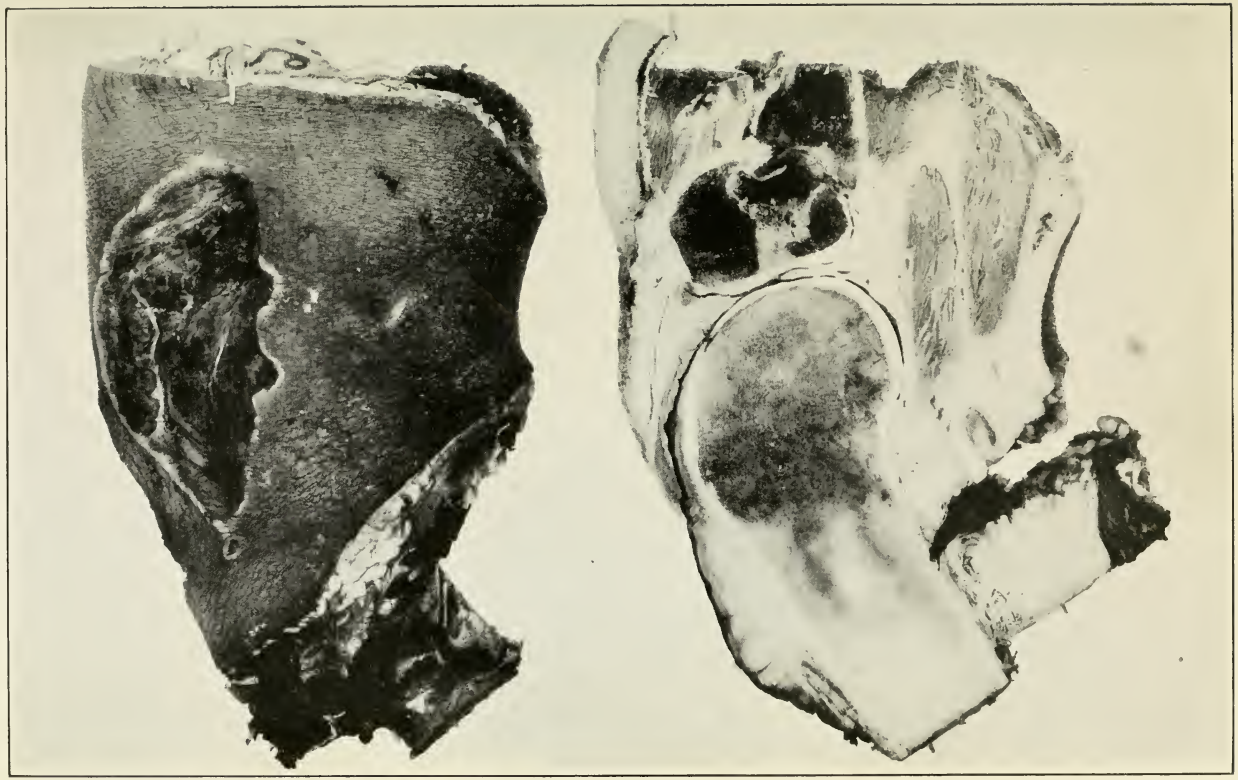

Fig. 9—Group 2—Class C.—High explosive wound of the right knee showing debrided wound and chronic osteomyelitis of the head of the tibia.

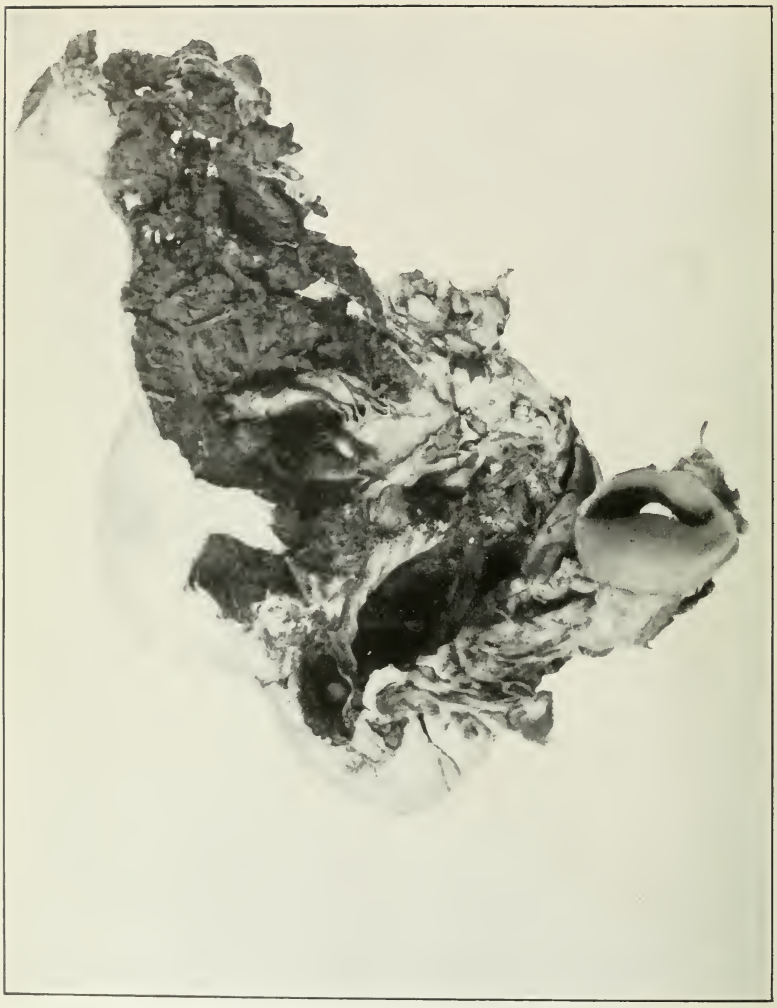

Fig. 10.—Heart with base and large vessels torn away by a missile which entered the right flank and passed out through the left shoulder. Soldier was said to have been thrown 20 feet.

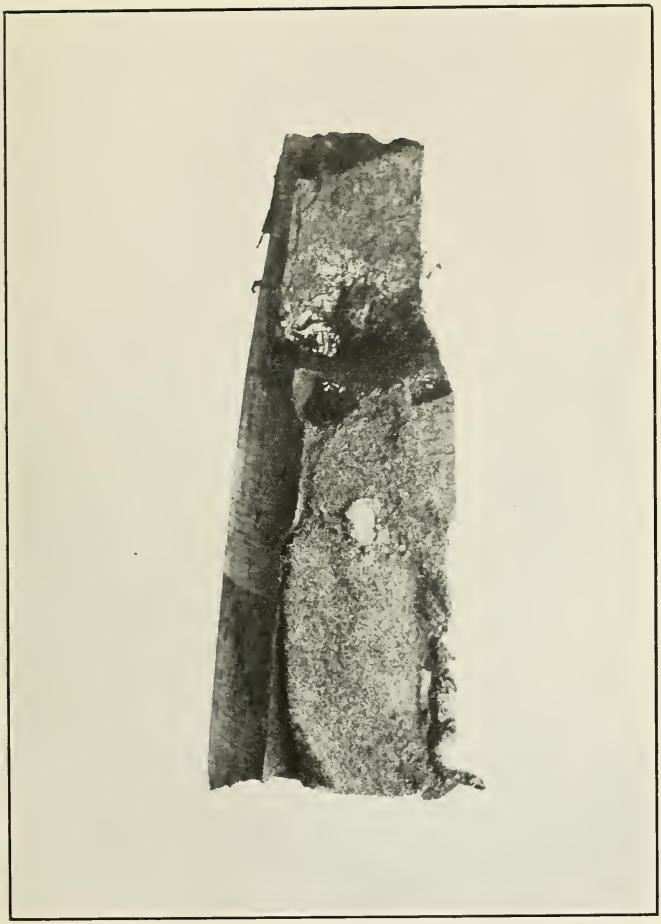

Fig. 11 (same case as Fig. 10).—Piece of a 210-mm. shell which entered the right flank, passed upward through the liver and out the left shoulder, fracturing the clavicle and first rib. Actua size. Weight, 937 gms. Note the attached piece of uniform on which is a drop of dried mud. This was found inside the soldier's shirt.

A vertical antero-posterior sawed section in the plane of the wound of exit shows a gangrenous softening of the belly of the biceps muscle, with an extension into the marrow of the lower end of the femur and into the knee joint.

Microscopical Description.—A section from the infected biceps muscle stained with MacCallum's stain shows peripheral liquifaction of the areas of Cohnheim, engor gement of the lymph streams and a large spore-bearing bacillus.

DESCRIPTION OF FIG. 5, GROUP III, CLASS A

Gross Description.—Specimen consists of a heart showing a diamond-shaped stab wound of the right ventricle. There is an irregular milk spot on the right ventricle approximately 2×3 cm. in area. There is a marked dilatation of left coronary. Death occurred in a few moments from hemopericardium.

Accession No. 4711

DESCRIPTION OF FIGS. 6 and 7, GROUP II, CLASS B

Clinical History.—G. S. W. left leg, severe, compound, comminuted fracture both bones with gas gangrene, due to high explosive. Wounded in the Argonne, October 25, 1918, at 2 a.m., died October 28, 1918, from sepsis due to gas gangrene.

Gross Description.—Left leg shows a wound measuring 3×5 cm. at middle of tibia, anterior midline, and a wound measuring 2×3 cm., 2 cm. inferior and 3 cm. posterior to the internal malleolus. The lateral X-ray shows two foreign bodies measuring 1×1½ cm. and 2×2½ cm. posterior to an extremely comminuted fracture of the tibia at the middle third, and an oblique fracture of the fibula at the same level. There are multiple small foreign bodies in the same region and in the region of the os calcis. There is one large foreign body measuring 1½×2½ cm. in the midline just inferior to the posterior margin of the os calcis.

The vertical section through the tibia shows the typical brick red discoloration of the calf muscles due to the gas gangrene group in comparative purity and the darker changes produced by the lower groups of the putrifiers around the wound tract. The tibia shows the typical multiple comminution produced in cortical bone by high explosive fragments, and a well-advanced abscess of the marrow cavity in the procimal end of the fractured tibia.

The section through the fibula shows an oblique fracture of the bone at the middle third and a foreign body measuring 1×1½ cm. embedded posterior to the lower end of the proximal fragment. Above and external to this foreign body and probably produced by the material carried in by it, is a marked fragmentation of the calf muscles caused by the formation of gas in it by the members of the gas gangrene group.

DESCRIPTION OF FIG. 8, GROUP II, CLASS B

Specimen consists of the upper third of the left leg and part of the tissues about the knee from a resection at the knee joint. The muscles of the calf are shredded by an intense gaseous emphysema. The subcutaneous tissues of the calf show a dark discoloration due to the putrefactive members of the gas gangrene group. High explosive shell wound.

DESCRIPTION OF FIG. 9, GROUP II, CLASS C

Specimen consists of a right knee joint with 10 cm. of femur and 15 cm. of the lower leg. There is a debrided wound 7×3 cm. on inner side of patella and one 10×4 cm. on the outer side of leg over the head of the tibia. On resecting back an upper

flap with the patella attached the exposed joint shows all synovial membranes covered by a purulent exudate. There is a loss of substance with fracture in the head of the tibia measuring 2×3×3 cm., the cavity being lined with a purulent exudate.

DESCRIPTION OF FIGS. 10 AND 11, GROUP II, CLASS A

Specimen consists of a heart and a fragment of 210-mm. shell which entered right flank at McBurney's point through a wound 3×7½ cm., passed to right of cecum without injury to it or rest of intestine through left lobe of liver, through lower lobe of left lung tearing off the base of the heart, fracturing the first left rib, and leaving through a wound 3×7 cm. on the posterior aspect of the left shoulder. The projectile weighs 927 grams and has on the surface that apparently struck the soldier first, a piece of olive drab wool neatly punched out of the overcoat and exactly the size of the impacting surface. Soldier is said to have been thrown some twenty feet from his place as an orderly on a Ford ambulance. There was very little blood on the body or uniform of the deceased. The heart is only intact for 4 cm. up from the apex; the base is a lacerated shredded mass.

OBSERVATIONS ON THE TREATMENT OF COMPOUND AND COMPOUND COMMINUTED FRACTURES[1]

By Captain JOHN E. WATTENBERG
Medical Corps, United States Army

OF THE great number of men who were wounded in the World War, a considerable number suffered from fractures. Most of these fractures naturally were of the long bones. More generally than is perhaps the case in civil life, these wounds were practically universally badly infected, and often the general health of the patient was seriously impaired, even months after his primary injury. Thus his resistance was low and he often regained his health slowly.

Whether these cases were seen soon after their injury or a considerable time later, no one could help but draw some valuable deductions from the treatment of such cases. Although this series represents, in a fair way, the general nature of all of the fractures taken care of at this hospital, this paper deals only with those who were personally observed and whose records were personally kept. Perhaps the experience would prove most valuable to the industrial surgeon, but sooner or later many of these men will find their way into the different clinics, wherever they may be. Hence the following study may prove of some interest.

There were studied carefully 409 cases of fractures. The ages of these patients ranged from eighteen as the lowest, to forty-three years as the highest. The average age was twenty-five years. They had, with five exceptions, been injured overseas, and an average of 3.6 months has elapsed prior to their entrance into General Hospital No. 26. Although some of the men had regained considerable strength, the average man still looked the "worse for wear" and needed building up generally.

The bones injured were as follows: Humerus, 89; tibia, 72; femur, 46; radius, 44; ulna, 40; fibula, 35; metacarpals, 18; tarsals, 13; scapulae, 11; phalanges, 9; patellae, 8; ribs, 6; vertebrae, 6; astragalus, 6; carpal bones, 4; mandible, 3; os calcis, 3; temporal, 3; sternum, 2; frontal bone, 2; clavicles, 2. Of the cases having several bones broken there were fractures as follows: Number of cases with fracture of tibia and fibula, 25; ulna and radius, 16; femur and tibia, 9; humerus and radius, 5; humerus, radius and ulna, 3.

There were 59 patients who had operations within thirty-six to forty-eight hours after injury and had none subsequently. All others

[1] From the Surgical Service U. S. G. H. No. 26, Fort Des Moines, Iowa, September, 1919.

were operated upon two or more times, usually for the removal of sequestra, or for pus pockets.

Doubtless a great many of the infected fractures would have required reoperation regardless of how careful one might have been in performing the first operations. Perhaps the main reasons for reoperations were that at first it was difficult to determine just how much removal of bone and soft tissue was really necessary, and so not enough was done at the first operation. A more frequent cause for reoperation was the fact that the wound was not properly sterilized after operation. This requires more patience and greater care than the operation itself. Rocher[2] says healing depends not only upon a perfect and complete operation but also on the "care and vigilance with which the focus is tended until definite healing results." He thinks small bone fractures —for example, of the ulna and fibula—may heal in two months, but that it takes the tibia, humerus and femur three to four months. He calls attention further to the fact that bone tissue is slow to regenerate and has little power of defense against infection. The operation is done once, or should be done once, in the majority of instances, while dressings must be taken care of daily and antiseptics applied correctly several times daily for weeks at a time, and perhaps even months.

There were 22 cases of simple fractures, 154 compound fractures and 233 compound comminuted fracturs. In 41 cases there was loss of bone substance (½ inch to 6 inches). There were 163 instances of osteomyelitis. Though some of these were, of course, slight and resulted only in removal of small spicules of bone at dressings, there were 86 that had sequestrectomies under general anesthesia. Nitrous oxide-oxygen anesthesia was used in all the cases.

The time from the operation for removal of the sequestrum to the healing of the wound, ranged from two weeks as a minimum to seven months as a maximum, with 2.9 months as an average.

The time from the date of injury to the healing of the soft parts ranged from three weeks as shortest, to fourteen months as longest time, with 5.3 months as an average.

Treatment, prior to entering the hospital, ranged from one month to sixteen months, with an average of three and one-half months. Many of the men had been in a number of different hospitals here and abroad. Persistent treatment thus was difficult to carry out, and hence the prolonged convalescence.

There were 19 cases of bone grafting. Two of these had bad post-operative infections, but in this series none of the grafts was a failure.

[2] Rocher, H. L., "Chronic War Osteomyelitis" Archives Medicine et de Pharmacie Militaires Paris, June, 1917, p. 717.

The time elapsing between the healing of the soft parts and doing the bone graft, ranged from seven days to three months. The average time waited was six weeks. This time depended a good deal on the appearance of the wound and general health of the patient. To operate on the average case in less time than was allowed was found to invite infection, possibly frequently by lighting up the infection still present. This might be explained by the low resistance of the tissues or by the fact that many of the wounds, though healed, still had present living microörganisms. This was demonstrated numerous times by culture of wounds as well as of foreign bodies which had lain imbedded for months but still yielded staphylococcus on culture.

There were 28 cases of plastic operation. These were usually of the nature of skin graft, pedicled flaps, or the skin-slide operations. These were used in cases with extensive scar which refused to cover over satisfactorily with skin, or in cases where denuded bone was present. The skin-slide operation was done to fill in deep bony cavities which it was impossible to cover with skin in any other way. This was done by the turning of a narrow pedicle with a broad base, into a deep bony cavity, fixing the tip of the pedicle into the deepest portion of the cavity by either a suture, or, in other cases, by merely the use of a tack. There were two such instances of the sternum, and two of the ilium. When healed, this left, instead of the wound, a depressed area which was covered over with skin.

Internal fixation with wire or metal plate had been done prior to admission in 7 cases. Four of these had subsequent sequestrectomies. There was no operation for internal fixation with metal done at this hospital in the series studied.

In several instances of fracture at or near a joint the healed wound resulted in a joint in mal position. This was remedied under an anesthetic and usually followed by a cast or other external appliance. In the series observed there were 11 such cases of forcible correction.

As is usual, the nerve adjacent to a fracture was often injured. There were 111 nerve injuries. The musculo-spiral was injured in 43 cases; the ulna, 20; anterior tibial, 19; median, 15; larger cutaneous branches enough to produce areas of anesthesia of considerable extent, 5 cases; auxillary, 4; intercostals, 2; posterior tibial, 1; sciatic, 1; spinal accessory, 1. Twenty-seven cases were operated for their nerve condition, while 29 had sufficient signs of return of function so as not to necessitate interference. Others will doubtless require operation while still others will perhaps regain function without it.

In the observation of a considerable number of patients one is struck by the fact that there was seldom a patient who had had fewer than

three operations. This is of course accounted for mainly by the presence of the pus-producing organisms or the presence of foreign bodies, or both. This results not so much from the re-formation of new foci of infection nor from re-formation of sequestra, but rather from not being thorough enough in the removal of infected material and dead bone in the first place.

The treatment of these wounds has been in the main rather uniform. It consisted of the removal of the foreign body and removal of the devitalized tissue by excision. This was followed by an attempt to sterilize the wounds with antiseptics. Metcalf [3] in his summary of treatment of these conditions names "adequate debridement" as the first operative measure. This procedure was advocated by Dr. M. B. Tinker [4] in 1909. It required war-time surgery, however, to popularize it. In the latter paper the author suggested protection of the open wound by packing it with tampons of sterile cotton, or gauze saturated with sterilized oil, and the preparation of the skin about the wound for an aseptic operation. He then carefully swabbed the lacerated tissues with a powerful germicide. Following this he advised the excision of the tissues damaged by injury or germicide, finally "closing the wound without drainage usually, there being only healthy tissue of good vitality."

If in the cases requiring sequestrectomy "wide excavation" is done thoroughly, the wound left open and antiseptics properly applied, re-operations should not be so numerous. The total number of operations done on these patients is 1,018. This is a large number when it is considered that 11 cases had no operations at all and 59 had only a primary operation. And among these operations counted are not numbered the nerve operations nor the operations done for the removal of foreign bodies. The large majority of these re-operations were sequestrectomies. Leriche and Policard[5] call attention to the fact that "the white denuded bone in a war wound is actually dead and as much a foreign body as an engrafted segment of bone." "All this material must be removed, for it obstructs the Haversian canals, and when that is the case, normal repair is hampered."

There seems to be quite universal agreement on the necessity of sterilization of these wounds. As to the choice of antiseptic to be used there is considerable difference. Decomps and Richard [6] use 10

[3] Metcalf, C. R., "Fracture of the Femur; the Application of War Lessons to Civil Practice." *Ann. of Surg.*, November, 1919, lxx 603.

[4] Tinker, M. B., "Radical Conservatism in the Treatment of Compound Fractures." *New York State Journal*, May, 1909.

[5] Leriche and Policard, "Dead Bone in Case of Fractures." *Presse Medicale*, Paris, September 19, 1918.

[6] DeComps and Richard, "Ether Dressings." *Paris Medical*, September 21, 1918, p. 229.

to 40 c.c. of ether in their infected wounds three times a day and thus "prepare them for secondary closure." Morison [7] illustrates by charts the relative germicidal effects of Carrel-Dakin solution, flavine, dichloramine-T, hypertonic salt solution and Bipp (bismuth subnitrate, iodoform and liquid paraffine), "proving that Bipp is the most active germicide." Leibinger [8] also claims excellent results for Bipp and many others have found it efficient as an antiseptic. Many other antiseptics have been employed and good results reported from their use. Perhaps the choice of the antiseptic is not as important as the persistent care with which the chosen antiseptic is used. Dunham [9] has studied the different antiseptic agents exhaustively. It was his conclusion that the "chlorine group of antiseptics offer better promise of completely meeting the requirements than any other substances." Of the latter Dakin's solution and dichloramine-T were employed in all of our cases and gave satisfactory results. Dichloramine-T was used principally in sinuses and surface wounds.

Dakin's solution, when used in these wounds, is a great time saver as well as a life saver. If the vessels that are cut at operation are properly ligated, Dakin's solution can be begun on the same day of operation. It is not necessary to wait a day or two. This is merely a loss of time to the patient, both by permitting new bacteria to grow as well as by not getting rid of those present. Chutro [10] has pointed out that delay in using antiseptics after operation has the further disadvantage of permitting clots to form. Beneath these, bacteria find a place which is often not reached by the antiseptic, although the surface of the clot may be sterilized. The author points out that the clot may not be dislodged for a week, giving the bacteria, in the meantime, a chance to grow. Failure to sterilize such a wound is usually due to improper use of the antiseptic. The entire surface of the wound must be thoroughly bathed by the antiseptic, and this must be done often enough so as not to permit the bacteria to gain in number nor even remain at a standstill—they must persistently diminish in number. This cannot be determined with any reasonable degree of accuracy unless cultures are made and numbers of bacteria counted. This should be done twice a week routinely, taking the loopful of pus from the most suspicious area of the wound each time. Frequently, when

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[7] Morison, J. R. ,"Some Points in War Surgery." *Surg. Gyn. and Obs.*, October, 1919, xxix 348.

[8] Leibinger, H. R., "Compound Fractures Treated by Bismuth Iodoform Paste." *Mich. State Med. Soc. Journal*, December, 1917, xvi 489.

[9] Dunham, E. K., "An Application to Empyema of the Principles Underlying the Use of Antiseptics." *Ann. of Surg.*, August, 1918, xvii 143.

[10] Chutro, Pedro, "Bone Fistulas after War Wounds." *Jour. Am. Med. Assn.*, Septembe 1919, lxxii 751

this is done, errors of technique in the treatment and dressings are discovered early and can be remedied. If the degree of sterility or infection, as the case may be, is left to the judgment of the naked eye, the error may in time be discovered, but only after having been many times repeated and much time lost. Guillot and Woimant [11] say that 50 per cent of the men with fracture of the femur still have a fistula a year after the fracture unless amputated. Using Dakin's solution their "cures were complete" in an average of twenty-six days. In fracture cases cultures have the farther advantage often, of raising the suspicion of infected cartilages. As Moschowitz [12] has pointed out, infected cartilages must be entirely removed. Care must be exercised to heal the wound from within. It is safer to let the skin and soft parts retract, even though a skin graft later might be necessitated by it, than to permit the wound to close externally with opportunities for the formation of pockets to harbor bacteria. Buchbinder,[13] realizing the importance of keeping the wound patent until sterilized, advises cutting across the muscle tissues to facilitate their retraction, thus assuring patency of the wound for effective sterilization. The men had been obliged to shift from one hospital to another rather frequently and thus could not possibly get their necessary care. They were often admitted with perhaps one Carrel tube, closely hugged by scar tissue external-ward, but leading down to a pocket of pus of several ounces' capacity beneath. Such was the condition in the majority of instances where re-operations were found necessary. The open wound should have in it a sufficient number of Carrel tubes to permit bathing the entire wound. Gauze may be packed into the wound loosely, both to help in applying the antiseptic as well as to help hold the tubes in place. If the wound has been sterile for a week by daily count, it may have secondary closure or one may continue sterile dry dressings and let it close of its own accord.

Unfortunately only about one-half of these cases could be observed to the end of their convalescence. In these the results were substantially the same as found by the Committee on Fractures of the American Surgical Association.[14] Their observations were made on 1,745 fracture cases. They found that for compound fracture the period of disability for the femur was 13 months, of the leg 6 months, and the upper extremity 4 months.

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[11] Guillot and Woimant, "Suture of Old Infected War Fractures." *Journal de Chirurgie*, Paris, February, 1918, xiv 3.

[12] Moschowitz, A. V., 'The Treatment of Diseases of the Costal Cartilages." *Ann. of Surg.*, August, 1918, xviii 168.

[13] Buchbinder, J. R., "Gunshot Fractures of the Femur." *Surg. Gyn. and Obs.*, July, 1919, xxix 70.

[14] Estes, W. I. *et al.*, "Committee on Fractures of the American Surgical Association. Results obtainable in the Treatment of Fractures." *Ann. of Surg.*, August, 1918, lxviii 238.

THE STRATEGY OF THE MEDICAL SERVICE

By GUSTAVUS M. BLECH

(With 3 illustrations)

I. GENERAL REMARKS

"Strategy is a system of accommodations, the translation of knowledge into practical life."—*Moltke.*

WE HAVE just gone through the greatest war in American history. Never before has there been such a vast mobilization of medical men, more than one-third of the entire medical profession of the United States having served under the colors.

In spite of the bigness of the war numerically, it is believed that one can hardly refer to the medical officers as a class, as graduates of the greatest military school that ever was or will be—war.

The reason is to be found in the rapidity of the mobilization, in the short duration of the war, as far as actual campaigning is concerned, and, lastly, in the simplicity of the problems presented at the last period of a position or trench war.

But an unprecedented interest in things medico-military has been aroused even among medical officers of the Army who have filled professional positions merely, and it is hoped that this article will cause many younger confrères to maintain an interest in preparedness for possible field service either in maneuvers or in another test for our national security.

Strategy of the medical service is part of the strategy of an army in combat, with this difference, that while combat strategy plans and fixes position (selection of terrain) and method of attack or defense, medical strategy has only discretionary range within the frame of the combat strategy.

In other words, the selection of positions for and the manner of function of the sanitary units and formations of an army in the field is subordinate to the positions and functions of the combatant forces.

The combatant forces have one great aim—victory over the enemy. The medical service has one and one aim only—that of the combatant forces.

The combatant forces attain victory by overcoming the resistance of the enemy culminating in the gain of terrain; the sanitary forces *assist* in the attainment of victory through:

1. Moral support (the combatants know that professional care is at their disposal in the event of casualty).

2. Economic support (combatants are not interrupted in their work through the need of looking after fallen comrades).

3. Human salvage (the firing line is maintained in its integrity through the rapid return of soldiers placed hors de combat).

The function of the medical service in the field, therefore, is of a two-fold character:

1. To give professional care to all sick, wounded and disabled for the purpose of saving as many as possible for further duty at the front.

2. To care for all who cannot so be saved through an organized and humane transport to the rear.

Simple as this sounds, the execution of the duties of the medical service in the field may be fraught with many difficulties and complications with which only one familiar with all contingencies of battle can cope with intelligence.

And therein lies the difference between the work of the civilian practitioner and the medical officer at the front.

The civilian cares for one or a few under fixed conditions (home, ambulance or vehicle, hospital); the military surgeon has to care for many under varying conditions, each fraught with certain problems.

These problems are produced by the battle situation, by the terrain, by the character of the defense or attack of the enemy, and by the organization and equipment at the disposal of the medical service.

Modern battles terminate in victory in which case terrain is gained resulting in a forward movement of the army; or the decision is uncertain and unimportant, resulting in neither lasting gain nor loss of terrain (position war, trench warfare), or else the battle terminates in temporary or permanent defeat and terrain is lost, resulting in a movement to the rear.

From this it follows that for all decisive actions mobility of the troops is of prime importance, either for the purpose of clinching the benefits of a victory (occupation of enemy terrain, demoralization of the enemy's retreat through adequate pursuit) or of minimizing the effects of a defeat (escape from capture, organized retreat with rear-guard action to save as much terrain as possible and to preserve morale for further resistance in a more suitable terrain or with fresh forces).

The entire equipment of line troops (infantry, cavalry, field artillery) has been devised to insure mobility, soldiers taking with them in the field only what they can carry. Heavier equipment necessary at the front is moved in motor trucks or drawn by animals (cannons).

At that, a defeated force will lose valuable ammunition and supplies, which, by the way, are usually destroyed in order to minimize the material gain of the victorious opponent.

The medical service works or should work, with similar field equip-

ment. How far this proves effective we shall see later on. But that service has a problem of mobility with which the line troops do not have to reckon.

Assuming for the sake of argument that the medical branch of the army in the field could be so equipped as to match in mobility the line troops, the very nature of that service makes mobility, at least in its entirety, impossible, since we have to deal with a human burden which should not be moved—the gravely sick and wounded whose condition absolutely forbids transport.

Sanitary formations of an army or smaller combatant unit are part of the army or unit. To serve effectively they must remain with the line troops, that is to say, they must maintain contact with the combatant forces in advances or retreats. The maintenance of such contact by the diverse frontal medical units and formations, under all conditions incident to the fortunes of war, is a service which can rightly be called "strategy of the medical service."

II. OUR MEDICAL SERVICE BEFORE THE WORLD WAR

Before we can intelligently discuss the strategic problems of the medical service of our Army, it is essential to know something of its history.

Our medical service, as understood by modern armies, can be said to have had its beginning in the Civil War through the efforts of the Medical Director of the Army of the Potomac, Jonathan Letterman, who developed the idea of ambulance companies, organized on a plan effectively to convey the wounded from the battle field proper to the diverse formations for the aid of the wounded, located in the rear.

There is evidence in the German medico-military literature that Letterman's ideas have been appreciated by the Prussian and confederated German armies in 1870–1, in the war with France to a full extent, though the first application of the principles involved was experimented with in 1866 in the war against Austria.

In our Spanish-American War we had no ambulance companies, as constituted today, and certainly no field hospitals, as we understand today, at least not units which have been organized, equipped and trained for service as ambulance companies and field hospitals before or immediately after the outbreak of the war. What service of either character was rendered on Cuban soil was improvised, by detail!

Since that war we underwent a period of theoretic or rather scientific renaissance. Our little regular army began to think of the time when our nation might have to face a militarily more important enemy than we confronted in Cuba, with the result that, after a thorough study of the

systems of sanitary service adopted by the leading foreign armies, a definite scheme of organization was outlined. This consists of regimental medical officers and enlisted medical detachments, four field hospitals and four ambulance companies for each division. These units have been established in peace for existing divisions organized or tentatively organized in the Regular Army and National Guard. Provision was made for two evacuation hospitals for each division in the event of war. Occasionally one could see an evacuation hospital pitched. Aside from larger size and more complete equipment it differed little from the field hospitals.

The organization of line of communication formations and especially base hospitals does not come within the scope of this article.

Two books must be mentioned as priceless possessions of that period of organization, namely, (1) Straub, "Medical Service in Campaign." Published by P. Blakiston's Son & Co., Philadelphia. (2) A Study in Troop Leading and Management of the Sanitary Service in War by Morrison and Munson. Published by the Army Service Schools, Fort Leavenworth, Kansas.

Both books, which are obtainable at little expense, remain to this day and in spite of the experience of the World War, standard textbooks, the former outlining our entire pre-war sanitary service in the field in minute detail, the latter showing the function of the service in an imaginary war fought in the United States.

It is earnestly suggested that all interested who have not yet done so, and who are patriotic enough to be identified with the military services on the active or inactive lists, study these works at their leisure.

III. IMPORTANCE OF MILITARY ORGANIZATION

"In war everything is subservient to organization."—*Pirogoff.*

The great Russian surgeon, doubtless one of the greatest minds of his era, whose dictum we have selected as the motto of this section, has realized the importance of military organization in war as compared with the civil practice of surgery. Von Bergmann, the great Russo-German surgeon, goes a step farther and demands that all individualization, the pride of scientific surgery in peace, be sacrificed in campaign to pattern-like work. What he demands amounts to no more and no less than the adaptation of all surgical activities to strategic conditions. This particular part of our work belongs to the domain of military surgery in the field and can be touched here no further.

But though the expressions of both leaders in military surgery have come to be accepted as axioms, we have had a number of wars fought with modern firearms and weapons, which afford convincing proof that

inadequate organization of the medical service of an army is one of the principal defects penalized by defeat.

The Russo-Japanese War (1904-5) and the Balkan War (1912-13) prove this conclusively.

It will be worth our while to review some of the features of these wars, as regards the medical services of the nations concerned.

In Russia medical officers are neither military officers nor civil officials, externally characterized by "abbreviated" military epaulets. Col. Valery Havard, M. C., U. S. Army, who was officially attached to the Russian army in Manchuria as a military observer from December 7, 1904, until March 10, 1905, when he was captured by the Japanese in the battle of Mukden, in his report says:

> The Russian medical department does not yet possess complete autonomy, and it seems difficult, in high places, to get rid of the idea that, being a professional body, it is incapable of governing itself. . . . Transport columns, sanitary trains, the service of evacuation are still in charge of line officers. I believe that this war will tend to show the great evils of divided responsibility. . . .
>
> Bearers do not form part of the regular medical personnel, and probably are always an uncertain quantity. . . They . . . give first aid to the wounded, so far as practicable, and bring them to the dressing station (under command of a line officer: G. M. B.). . . a majority of the wounded would still find their way to the dressing station on foot, helping each other or helped by sound comrades who left the ranks for the purpose.

Though the regulations of the Russian Army provided ample medical service something went wrong:

> It is possible that the field hospitals "at large" were not mobilized or sent to the right places, thus reducing the divisional strength of the hospital corps by 222 men. It is also probable that all the regimental bearers were not turned out . . . and all these possible irregularities were certainly accentuated in the medical work of the front by the lack of authority and, therefore, the sense of irresponsibility of military doctors who are not officers, as well as by the lack of experience in field work of a majority of them, namely, those coming from the reserve.
>
> At the dressing stations I visited I noticed a general laxity of discipline and want of organization, as if nobody was in command and responsible. . . .
>
> In the Harbin hospitals I saw patients who had between one and two weeks without medical attendance (at the front G. M. B.). . . .
>
> As to the means of transport from dressing stations to field hospitals, they were woefully lacking and defective. There were few available stretchers and no ambulances.
>
> During the various engagements of the battle of Mukden the bearer companies and transport columns which came under my observation appeared to me strangely careless and inactive.

Colonel Havard narrates that while the Mukden fight was going on all along the line he saw bearer companies halting and resting and the best equipped transport column he had seen lying idle in camp, and rightly expresses his belief "that this want of diligence and activity, be-

traying incompetency and defective organization, is chargeable to the line officers who are in command of the means of transport."

In an article published in the May, 1912, issue of THE MILITARY SURGEON the author,[1] speaking of the failure of the now famous Mishchenko raid, said:

> Now came something noteworthy: Kuropatkin had advised the use of horse-drawn wagons on two wheels, the horses to be selected with care. He had written: "These wagons will not fall behind the command and when freed from their loads will constitute your sanitary transport." But Mishchenko did not heed the advice of his superior—at a price, as will be seen, dear enough. . . .
>
> Toward morning the order came to place all the wounded . . . on stretchers and Chinese carts, and to start back, so as not to hamper the column, for the commanding general had received disquieting reports of a planned advance by the enemy. The number of stretchers was extremely limited and Chinese carts fewer still. Now began a search for carts, overcoats and blankets. . . . Under such horrible conditions the retreat began. The suffering of the gravely wounded on the carts defies description. Many begged the surgeon to shoot or poison them. . . . Morphine and opium were given freely, but to no purpose.

In a personal communication to the author a distinguished observer expresses himself about this cavalry "raid" in these words:

> The failure of the raid was largely due to failure to supply adequate transport for wounded. This resulted in the use of Chinese carts which delayed movement so much that whatever chance there might have been was destroyed.

Were it possible to quote from the numerous official, semi-official, and private publications by Russian medical officers, it could be shown that all are agreed on the following propositions:

> 1. The Russian medical corps is controlled by high ranking line and staff officers who have moved about field hospitals in a senseless and purposeless manner merely to show that they were not idle, with the result that in some places where most needed there were none functioning, thereby creating unnecessary suffering.
>
> 2. That the morale of the Russian troops was shaken through lack of medical organization, the lines becoming depleted through healthy combatants acting as "guides" and "supporters" of wounded comrades, while those who could not so get away dreaded injury in the knowledge that they would have to drag themselves for many a mile until they would find shelter, a glass of hot tea, and professional care.

Troops so demoralized do not fight well. The lessons are obvious. Contrast with the above what we learn about the Japanese medical service.

In a monumental report of an exhaustive character, Col. Charles Lynch, though acknowledged one of the most conservative officers of our regular army medical corps, has this to say:

> . . . it should be stated that administrative officers of the medical department generally were in close relation to their commanding officers; their control of their own department was complete.

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[1] "The Russian Army Medical Service in Manchuria—A Critical Review of Some of its Phases," by Gustavus M. Blech.

. . . Officers generally in Japan are informed on the importance of the medical department as a part of the body military and its true functions with an army. . . .

. . . Due weight appears to be given also to the opinion of medical officers on any contemplated movement of troops, of which they are informed and for which they take part in conference.

. . . Any friction between officers of different branches of the service would be entirely contrary to Japanese ideas of patriotism, and all officers work harmoniously in the grooves fixed for them by regulations. . . .

Speaking of the Battle of Mukden, the medical conduct of which has aroused bitter criticism by Colonel Havard for the Russian service, Colonel Lynch, who devotes a large chapter to the details of this important conflict, remarks:

The medical department, according to regulations, had full information on contemplated movements leading up to the battle, and therefore was able to make complete preliminary arrangements for its own work. . . .

. . . The Sanitary Reserve Personnel, the field hospitals, and the sanitary companies each had about five times the regulation amount of supplies.

Colonel Lynch goes on to show that transportation was increased and coolies to litter the patients were freely hired. The activities of the diverse sanitary units and formations, though not perfect in professional details, were functioning wherever placed, many running smoothly. This is also apparent from a large map showing the actual positions of the sanitary units on the arena south of Mukden.

Of course the excellence of the Japanese medical arrangements was not the sole reason of success, but it certainly still more enhanced the fighting courage of a patriotic army, imbued by patriotic ideals.

Russia was primarily a military power. It had the largest regular army in the world. Well may it be considered that for Russia the war in Manchuria meant only a colonial war, the reason for which did not enthuse the majority, while Japan was fighting for ideals. It cannot be denied that both arguments carry weight. On the other hand, even the most enthusiastic soldiers will not endure long if they are not well fed, shod, clothed, sheltered and taken care of when wounded. Morale must be sustained by proper organization.

Similar conditions are encountered in a study of the Balkan War. When one considers that Bulgaria, Servia, and Greece have hated and fought each other for a long time and suddenly sprung a surprise on Europe by a coalition to throw off the yoke of Constantinople by the combined force of arms, the "ideal" was on the side of the Christian nations. But the Osmanic army had war experience, had but recently received military "retouching" by Freiherr von der Goltz, and above all the Mussulman is or rather has been notorious as a professional fighter.

There were errors by the Turkish war office. Mobilization, to offset

the well-planned mobilization and war feints of the Bulgaro-Servians, had to be rapid to make up for neglect. The medical arrangements were highly unsatisfactory, as was the supply of ammunition and food. Not until the Turks had concentrated on the so-called Chatalcha line was their organization worthy of a name.

Mahmud Mukhtar Pasha, commander of the II East Army, wrote an interesting book on his leadership in that war. He blames the poor organization and general demoralization of the officers corps and of the nation for the defeat. He says nothing about the medical arrangements, but he himself was wounded and left to his fate on the field until an orderly dragged him away.

Compare with this Corrado Zoli's statement that the care of the wounded Bulgarians became a service of love to which everybody contributed everything possible. While the medical service was not ideal, the soldiers felt they would be looked after, if wounded, and did not worry. The Turkish army had an adequate number of field hospitals, but the transport service between the firing line and these formations had broken down because it was neither adequately provided for nor well organized and disciplined.

These samples will suffice, it is believed, to show that an army without a well-organized medical service is unthinkable as a fighting force.

IV. LESSONS OF THE WORLD WAR

As has been alluded to, the World War as a school of medical strategy has been something of a disappointment. We began with a position war on a terrain previously held by our allies. Most regimental aid posts, dressing stations and field hospitals had been established by the French, so that all we had to do was to take over their positions.

Fortunately for us we had no retreats, at least not in a strategic sense, so that the tactics of our medical formations were very simple and, accordingly, easy of execution.

We learned something as regards the inadequacy of our field hospitals. We had, of course, here and there, field hospital personnel close to the front established in permanent buildings, functioning as evacuation hospitals, some even having female nurses on duty, and we increased the personnel and equipment by so-called mobile operating units to augment the surgical facilities of the field hospitals.

As regards service at the British front, our field hospitals and ambulance companies had to undergo a temporary modification to harmonize with the English "field ambulances," which represent an American field hospital and ambulance company combined.

The advantage of such a scheme is not apparent. Certainly our field hospitals as constituted before the war are an anachronism.

That other civilized armies still continue to maintain them is a fact, but the time for us to follow others and accept foreign teachings as authoritative has gone by. Our regular army medical corps has not only "graduated" but can now assume the rôle of international teachers and, we feel confident, will in the near future recommend changes in our organization and equipment which will increase the usefulness of the medical service at the front.

We can safely maintain that with the exception of the use of extension splints on the firing line and the value of "surgical sterilization" (*débridement*) of gunshot wounds within a few hours after the receipt of injury, nothing especially new has been brought out by the World War.

Perhaps, after all statistical data shall have been tabulated and weighed, it will be found that, under favorable conditions, conservatism in the treatment of many wounds need no longer be adhered to, but on the whole the rules concerning the transport of wounded, that is to say the transportability of soldiers suffering from certain war injuries and the nontransportability of others have hardly been changed, except that with the extension splints properly applied transport even over comparatively long distances is fairly safe, as far as all compound, comminuted fractures of the extremities are concerned.

We are, however, not likely to fight another war under conditions such as we encountered in France, and in planning our future activities preparatory to another conflict all possibilities should be borne in mind.

An attempt will be made to show that an organization can be established, elastic enough to meet any and all contingencies.

V. ORGANIZATION OF THE MEDICAL SERVICE OF AN INFANTRY DIVISION

The division representing the great administrative and tactical unit organized to maintain itself in any action, we must glance at that machine before deciding what its medical service should be.

It cannot be our intention to prescribe what a division is to consist of with reference to the line troops, technical troops and staff corps, but we are able to appreciate the fact that the organization of our infantry divisions soon after their mobilization for the World War was too large.

This is evidenced by a new organization prescribed for in 1918. Even under that table one cannot but realize that certain sections were top heavy and the entire organization, though better balanced, still far from being easily controlled by divisional headquarters.

The French divisions, for example, seldom exceeded 15,000 officers and men as compared with our 33,000 and later 28,000 (approximately).

It is probably safe to assume that in future wars our divisions will have a strength of from 20,000 to 25,000 officers and men. This uncer-

tainty, however, does not influence our calculations with reference to the medical service to an appreciable degree.

An infantry division will consist of headquarters, 1 headquarters troop of mounted infantry and 2 companies signal corps attached, 1 regiment of engineers, 3 regiments of light and heavy field artillery, 4 regiments of infantry, 1 machine-gun battalion, 1 ammunition and supply train with a company of military police.

The medical personnel and units and their duties, briefly, should be:

1. *Headquarters.*

1 Division Surgeon (chief of the entire medical service of the division. Medical strategist on the staff of the Commanding General. Responsible for the organization, equipment and training of every medical officer and unit attached to the division. C. O. of Sanitary train.)

1 Asst. Division Surgeon (Sanitary Inspection. Adjutant of the Div. Surgeon in battle.)

1 Med-Supply Officer (San. C. Med. supplies).

Professional consulting staff (Surgeon Alienist, etc.), 4 medical officers.

1 Division Laboratory Chief (Water analysis, disinfection, epidemiologist.)

1 Junior Medical officer (surgeon for headquarters, Hq. troop and signal battalion.)

Total commissioned M. C.. 8

Total commissioned San. C., 1.

Regimental and Battalion Surgeons:

4 regiments infantry	at 6 =	24
3 regiments artillery	at 4 =	12
1 regiment engineers	at 3 =	3
1 machine-gun battalion	at 2 =	2
1 ammunition train	at 2 =	2
1 supply train	at 1 =	1
1 military police	at 1 =	1
Total commissioned M. C.		45

Medical Units:

Ambulance Battalion.			
4 ambulance companies	at 5 =	20	
1 C. O. of Battalion		1	
Total commissioned M. C.		21	
1 Adjutant (San. Corps)		1	Total commissioned San. C. 1
1 Mobile field hospital	at 6 =	6	Total commissioned M. C. 6
1 Adjutant (San. Corps)		1	Total commissioned San. C. 1
5 immobilized field hospitals	at 8 =	40	
1 C. O. hospitalization		1	
Total commissioned M. C.		41	
1 adjutant (San. C.)		1	Total commissioned San. C. 1

Grand total M. C.	121
Grand total San. C.	4
Aggregate, commissioned	125

It will be noted that the sanitary personnel for a division given above is about as large as prescribed in the Tables of Organization since 1917, nevertheless it is believed that the above arrangement is better balanced for reasons to be discussed later.

It will also be noted that the above arrangement provides no C. O. for the units known as the Sanitary Train but places the division surgeon in direct command. This, in our opinion, is as it should be.

Nor is this an impossible task.

The analogy for this can be found in the fact that the artillery brigade commander functions also as the divisional artillery officer and the C. O. of the regiment of engineers as the divisional engineer.

There is ample reason for the division surgeon to be with his ambulance companies, dressing stations and field hospitals during action.

To place the sanitary train under a commander not a medical man is an absurdity, nevertheless to all intents and purposes the C. O. of the divisional train commands also the ambulance companies and field hospitals, and the C. O. of the sanitary train, as now provided, assumes full and independent command, subject to direction by the division surgeon, only after the commander of the trains releases the sanitary units. All this leads to division of authority, confusion, waste of valuable time and energy.

It will be held that the division surgeon has ample work in his office as such. This is true, under our present system of paper work and administration with unequal division of work.

The statistical reports from the diverse divisional units, for example, could be turned over to the epidemiologist for correction, tabulation, and charting. "Sick and Wounded Reports" should be abolished for all field formations, except the immobilized field hospitals.

With the medical supply problems handled by an experienced officer the routine work preparatory to war should leave the division surgeon free to devote himself to the tactical training of his units; and certainly, during battle, his place is there where he can be most useful.

If this be so, there is no need for an additional C. O. of the sanitary train, which in our service is an innovation, as before the World War (Mexican border service) we had directors of the ambulance companies and directors of the field hospitals, and while these two units were not united, except under the division surgeon, there was no hitch.

The duties of regimental personnel remain as given in the manual.

The ambulance companies have a two-fold function—the establishment of dressing stations and the transport of the wounded from the front to the field hospitals.

The selection of the dressing stations is a simple matter. They must

be accessible to a road, as near the firing line as consistent with safety (?), preferably in a village affording shelter, water, etc. Their present organization appears satisfactory, but their equipment should be improved to permit emergency operations of a vital character.

The field hospitals must be either what their name implies—and according to present organization and equipment they are not—or else, if evacuation hospitals be available, their *raison d'être* as such does not exist, unless it is intended to provide in the field additional dressing stations, affording shelter for a few days.

But for such purposes the present field hospitals are too well equipped, but not well enough to function as advanced evacuation hospitals.

The experiences of the World War tend to show that the medical service of the front would prove more effective if hospitalization could be given the wounded as early as possible after receipt of injury. If the field hospitals can hospitalize patients—and they can—there is no need for evacuation hospitals.

It is believed that a division should have six field hospitals, but only one of which should be mobile to accompany the division in advances. Such a field hospital should be motorized and have a bed capacity of 300.

The five immobilized field hospitals should have a total bed capacity of 2,500. The equipment should be arranged in "units," that is to say, the outfit should be able to divide the entire equipment in three sections, each of which should suffice to augment another hospital or, if need be, work independently.

For the mobile hospital the following personel will be needed:

1 major, C. O., and senior surgeon.

1 Lieutenant, Adjutant, supply, mess, etc., (Sanitary Corps).

5 captains, or lieutenants, Medical Corps; 4 operating surgeons, 1 anesthetist (bacteriologist).

1 sergeant, first class—first sergeant, admission records.

1 sergeant, first class—supplies.

1 sergeant, first class—commissary (mess).

10 sergeants (tentage, kitchens, records, motor repair and transportation, night ward master, operating room, dressings, special ward (internal diseases), supernumerary.

90 corporals, privates first class, and privates.

Tentage: 11 large tents (Gilchrist) or equivalent. (One as operating room with two operating tables, 10 to contain 30 beds each).

3 tropical tents (as office, admission ward (triage) and storeroom).

7 wall tents for officers, 3 conical tents for N. C. O.'s and 15 conical tents for the rest of the personnel. Transportation: 11 trucks and 2 side-cars.

As for the five immobilized field hospitals, they should have the equipment of evacuation hospitals, dressing boxes, bedding units, beds, tentage, kitchens, etc., being divisible by three.

The transportation is a matter of calculation.

To these units should be attached the consulting staff from headquarters. One of these hospitals will carry a field X-ray equipment; another a complete bacteriologic laboratory, both of which serve all units.

Each such immobilized filed hospital, in addition to the officers, should have: 4 sergeants, first-class, 15 sergeants and 150 corporals, privates first-class, and privates.

VI. AN IMAGINARY WAR

Let us assume the following piece of fiction to be reality. The author has borne in mind several phases of war which ought to demonstrate whether an organization as proposed in the preceding section is practicable. It may be added that the terrain is not altogether imaginary. It is realized that no "map maneuver" can replace actual experience, but, as a matter of fact, problems likely to be presented by actual war are solved on the map as well, if not better, than actual terrain under the stress of battle.

The narrative in the first person of an imaginary medical officer is believed to be a palatable vehicle at least for such readers who experience difficulty in visualizing technical descriptions.

WAR DIARY OF DR. YOUNG

February 16, 1922.—At last the exchange of notes has come to an end. The South American republic of Paragonia, blinded by indescribable hate for the "big brother" north, has thrown down the gauntlet. Uncle Sam has no alternative but to fight. It is no easy task at that, I am told by Captain Enright of the Engineer Corps, who has been there and knows the people and their army. The country is almost tropical, hilly, with but few good roads and railroads. Enright says that the Paragonians will fight to the last ditch and that no victory will be complete until we have entered the city of Paragonia, their capital, in a position to dictate terms (Paragonia city is fortified in a modern sense). I telegraphed the Surgeon General of the Army requesting assignment to active duty under my commission as a first lieutenant of the M. R. C. Inasmuch as I have served in a field hospital in the A. E. F. I hope for assignment with a like organization with increased rank.

February 17.—No reply from the S. G. as yet. My Encyclopedia Britannica has a small but fairly practical map of Paragonia. All I can learn is that, like all South American countries, it is accessible via the Atlantic and Pacific oceans, that the capital lies almost in the very center of the Republic—200 miles from either coast.

February 19.—Hurrah! A telegram from Washington orders me to report to the C. G. of the 62d Division at Camp Columbia, near Tampa, Fla., not later than the 25th, just time enough left to get some new camp equipment, wind up affairs and make the journey.

February 26.—This is a new division they are assembling in Florida. More than one hundred doctors are already in camp. We reported to the division surgeon yesterday. We are sent to the camp hospital for the present, pending definite organiza-

tion of the new regiments and the sanitary train. Some of us had been in the World War. The division surgeon, to my great surprise, seems to care far more for surgical experience than military training. Not much chance for me—a general practitioner! We have to furnish all information about graduation, hospital training, practice, military service, etc., on blanks furnished us.

February 29.—The service in the camp hospital amounts to a professional test. This became apparent when two new officers who claimed to be surgeons were sent away. They were given an opportunity to do a minor operation under the supervision of the chief of the surgical service, and they failed.

March 2.—First conference in division surgeon's office. Colonel Worth, M. C., outlines the duties of the regimental surgeons, the ambulance personnel and the mobile and immobile hospitals in the field. I beheld the gist of the whole talk in one sentence: "The personnel nearest the firing line should evacuate to the rear as little as possible; the personnel on the rear should aim to evacuate to the front as much as possible." Another sentence struck me as forcible: "It is impossible to discuss the transport of wounded from the standpoint of the organ involved. Each class of injuries may present phenomona of a variable character, calling for immobility or immediate transport, depending on the very character of the injury. To illustrate, take a gunshot wound of the abdomen. Some of this class of injuries will be safest if left severely alone for a few days; others may be saved only by laparotomy performed within an hour or so after receipt of the injury."

March 3.—We received our permanent assignment today. I am to command an ambulance company, because I know something of map reading and drill. For a field hospital, I am not surgeon enough. Colonel Worth wants trained surgeons only—even the C. O's.—in the field hospitals. His ideas begin to dawn on us. The field hospitals must cure nearly all cases. Only those patients who will be useless for further military service, or whose injuries will incapacitate them for months, should be evacuated.

"The old idea of keeping field hospitals as empty as possible so as to allow bed space after each action is all right, but combat tactics have changed and with our facilities we should never be full, even after half of the division has been reorganized by replacements." Personally, I doubt that very much; the books I have read do not agree with our enthusiastic and able division surgeon. We shall see!

April 10.—Our training is over. Oh for the many lectures and terrain maneuvers, Each of us has made a map of a limited area, has drilled his outfit, has pitched a dressing station or field hospital. The regimentals "have pitched" aid stations under the bare sky. We have learned our regulations, manner of making reports, of caring for the dead; we have even had some lessons in Spanish. It was a wonderful course. If Colonel Worth's teachings turn out in the field as successful as they appear from the blackboard, we shall function like clockwork.

We were inspected today. We had to show two watches, an electric flashlight, notebook, pencils, compass, and a small haversack for tobacco, pipes, books, and one change of underwear. I confess not a detail has been overlooked. Even our "passports" are in our possession. We are to embark for Paragonia on the 15th.

April 26.—We arrived yesterday without a mishap at Zagora, a city of about the size and appearance like Cleveland, Ohio, but one of Paragonia's foremost seaport towns on the Atlantic. Everywhere American flags over larger buildings. M. P.s and infantry patrols can be seen on every important thoroughfare. Zagora has two base hospitals each of about 3,000 beds; more are to be established soon. I visited both and found them well equipped. Zagora is our base of supplies. I

secured anything I wanted from cigars to pocket lamp batteries. The heat is terrific. We are allowed to live in campaign shirts. As for the situation we can learn but little. Zaroga has been taken by the Americans without a shot, the navy having disappeared and the army withdrawn to the interior to protect the capital. A few divisions of our regulars are already in contact with the enemy, but there is no intention to undertake an earnest offensive until our entire overseas force has arrived. Our division will not be fully assembled for a few days yet.

April 30.—We are slowly moving in a westerly direction in a company troop train. The first car contains some artillery and machine guns, posted for immediate action. "Lookouts" are placed everywhere. This train carries the ambulance companies and the mobile field hospital only. I understand a regiment of engineers and the headquarters company have gone ahead yesterday. Headquarters and some infantry are to follow tonight. The trip to the "front" lasts seventy-two hours. Sleeping facilities—none.

May 16.—At last war! We are to go into action tomorrow. I am relieved from the command of the ambulance company. Lieutenant Colonel McCleanzy, sanitary inspector, is sick. I am to take his place and function as Colonel Worth's adjutant too. While I regret the loss of my command, I shall probably have a greater field of usefulness. I am initiated in the war plan. The capital will be attacked from the north. For the past two days we have heard the boom of heavy cannon. The enemy is strongly entrenched in a circular line around Paragonia. The most forward positions are nearly 50 miles from the city proper.

Division headquarters is at Sacramento, a small village. I rode from here with Colonel Worth to all regimental aid stations and the dressing station early in the morning. This afternoon we inspected the field hospitals. I append a rough sketch of the situation, which I drew from notes and the blue-print maps furnished us from the general headquarters.

The difficulties we have to contend with consist principally in the inadequacy of transportation. Between Zagora and the city of Paragonia is but one double-track railroad, running in a straight line, eastwest. Two divisions straddle the railroad, but our division, as can be seen from the map, is not only 70 miles from the railroad, but that is hard to reach, as the mountainous roads are too narrow and in too bad a shape for extensive transportation. Indeed our march into position, which began as soon as we detrained at Hialo on May 3, lasted nearly five days, due to our desire to retain contact with our transport columns, which are motorized. Rations, ammunition and other supplies are being delivered without a hitch, however.

This situation explains the reason for the slow but adequate preparations for attack. Each frontal sector has so many reserves in depth that any counter-attack would be checked with ease. We are also certain that we cannot be outflanked, though we do not know to what extent the enemy may be reenforced from the south and southwest. We learned that a million men have been mobilized and that the enemy maintains several training camps for reserve, which are said to be beyond our reach. However, they have not reckoned with our aviation corps, which will soon have a strong representation here.

Accordingly Colonel Worth recommended to the Chief of Staff the following disposition of the sanitary units:

1. Regimental personnel to accompany the regiments and to establish aid stations at places within the regimental areas protected against enemy fire.
2. The main dressing and assortment station to be in Onaga Distillery (see Fig. 2).
3. The mobile field hospital to be at the outskirts of Sacramento.

4. The immobilized field hospitals to remain at Tana, north of Sacramento, one to be pitched, the others to remain unpacked to await orders.

The Chief of Staff did not at once approve but demanded the strategic reasons for this disposition.

Colonel Worth replied that as no one can tell the kind of a defense the enemy will put up, he has the mobile field hospital in the most advanced situation, affording relative safety and reducing the transportation distance to the minimum for those needing immediate surgical assistance. For those requiring prolonged hospitalization Tana is ideal because it has water and village facilities, in addition to being easily reached by motor. Should an advance take place very soon, sooner than would be the case with a disciplined antagonist, he would transform the mobile hospital at Sacramento into an immobilized hospital, bring up a section from Tana and increase the facilities at either place as conditions permitted.

This idea proved practicable, was accepted, and added to the general battle order.

Colonel Worth sent the following field messages:

1. C. O. Ambulance Battalion, 62d Div. V. 16, 22, 5. p. m.

Proceed at once in accordance with previous oral instructions on the road Sacramento-Alma north, taking the entire battalion less one ambulance and chauffeur, establish a dressing station at the Onaga Distillery and arrange also a slightly wounded camp in immediate vicinity.

All cases requiring surgical intervention should be sent to mobile hospital along the road immediately south of Sacramento. All cases requiring hospitalization should report at that hospital for inspection by Officer of the Day and on his instructions proceed to Tana, about 10 miles south of Sacramento, to the C. O. of hospitalization.

Instruct chauffeurs to keep to righ of road and not to interfere with trucks of train.

I will be at Sacramento until 3 a. m. Will join you at about 4 a. m.

WORTH.

2. C. O. Mobile Hospital, No. 62. V. 16, 22, 5 p. m.

Pitch your hospital at place agreed on this noon. Prepare your operating team to begin work not later than 8 a. m. tomorrow. Appoint one officer as O. D. to not only receive all patients sent directly to you but to examine all patients sent from the dressing station to hospitalization center at Tana to determine whether transport is safe. Retain those in need of surgical attention (especially secondary hemorrhage cases) in spite of their original destination. If in need of more bed capacity or help send messenger to dressing station at Onga distillery, on right of road Sacramento-Alma. WORTH.

3. C. O. Hospitalization, 62d Div. V. 16, 22, 5 p. m.

Open at once one complete field hospital your section at place designated yesterday. That hospital should take over X-ray service and bacteriologic laboratory. Prepare to receive patients tomorrow not later than 9 a. m. Prepare for light diets for 100 and semi-solid diets for 150. Telephone will be installed soon; meanwhile send all urgent messages to Message Center, Div. Hq. Keep each other section in shape to pitch or move forward as orders will reach you. Report by messenger when above order has been complied. WORTH.

After supper I sat up for a long time, and while smoking I reflected somewhat on the situation. Deep in my heart, with all the confidence in the chief surgeon's ability, I still had that dread of something going wrong. I was tempted to take a pencil and estimate the possible casualties on a per cent basis, but I recollected an instruction given Major Carr of the 49th Infantry, which was to remain in reserve, to be prepared to go with his men to the assistance of any of the three engaged regiments, as one may be nearly wiped out while the other may hardly sustain any casualties.

Therefore I, too, must have confidence in a thorough coöperation of the units and just await what is to come. As tomorrow promised to be a hard day I went to bed.

May 17.—Colonel Worth and I left headquarters at 3 a. m., proceeding to the battle line. We had the main road clear, though we were halted several times by military police. When we entered the hastily thrown up entrenchments we saw the infantry resting on the ground fully dressed, only sentinels and listening posts being on duty.

We visited the three regimental aid stations. Each had markers beginning from the concerned road and trails. A few shelter tents being strung over poles like the roof of a small shed were to afford shelter to all who were not to be moved to the rear. The equipment was strictly that of the combat equipment, but each station had a litter rigged up on tree-stumps, so that the surgeons could dress patients with greater convenience. The station was so close to the hills that artillery could not reach it with ease.

We walked back to the distillery and found the park of the ambulance section. Colonel Worth expressed great satisfaction at the preparations. A field kitchen was preparing coffee and soup for the patients, if any.

A few minutes after we reached the dressing station our artillery began a drum fire, with an occasional shot from our howitzers, of which we had but a small number. The fire was no more intense than I have heard for several mornings past.

To my surprise it ceased after an hour, just as it had on previous days. Soon after, I could discern the cracking of infantry rifles and machine guns. It was evident to me that we had launched the infantry attack without an adequate artillery barrage. This may have been due to two reasons; first, to lull the enemy into the belief that the artillery preparation had today no other significance than that of preceding mornings; secondly, in the mountainous terrain the artillery could not produce any effect.

Be this as it may, the first ambulance began to come in early in the forenoon. For a while it looked as if the stream would continue throughout the day, but at 3 p. m. we received word that no more wounded were present.

The fire had ceased at 2 p. m., and I learned later in the afternoon that the attack had been stopped.

When I expressed my astonishment to Colonel Worth he replied that all this may be due to a well thought out plan and that all sensible medical officers should take advantage of every lull in fighting and get some sleep.

We went to the regimental aid stations, later returned to the dressing station and thence visited the mobile field hospital. The following figures were obtained.

Killed on the battlefield	61
Died at aid stations	4
Total deaths	65

67th Infantry.—Total wounded 49. Of these 7 were returned to the firing line and 42 sent to the rear.

42d Infantry.—Total wounded, 83. Of these 9 were returned to the firing line, 1 kept at station for pronounced shock, 73 sent to rear.

10th Infantry.—90 wounded; all sent to rear.

Artillery and 49th Infantry, no casualties.

Total sent to dressing station, 205.

Assortment:

G. S. W. of head, severe, 4—Ev. to F. H.

G. S. W. of head, slight, 1—Retained.

G. S. W. of chest, severe 6—Ev. to F. H.
G. S. W. of chest, slight 2—Ev. to F. H.
G. S. W. of neck, severe 1 (tracheotomy at dressing station)—Retained.
G. S. W. of abdomen, 3—Ev. to F. H.
G. S. W. of shoulder, 8—Retained.
G. S. W. of forearm, 4—Retained.
G. S. W. of hand, 1—Retained.
G. S. W. of thigh, 80—Ev. to F. H.
G. S. W. of leg, 91—Ev. to F. H.
G. S. W. of spine, 1—Ev. to F. H.
G. S. W. of face, 2—Ev. to F. H.
G. S. W. of chest and thigh, 1—Ev. to F. H.

Of the retained cases it was hoped to return 75 per cent to the front within thirty-six hours. The rest would be evacuated the next morning. At the field hospital they decided to laparotomize only one patient, perforation having been established beyond doubt. All head cases were treated surgically. No debridements were done, as the injuries were almost exclusively caused by jacketed bullets, and the wounds were comparatively simple.

During the night another infantry attack was launched by us, the enemy offering stubborn resistance. Nevertheless we succeeded in gaining a foothold on a hill running south of Alma. Toward noon the next day we had Alma in possession.

For three days our division fought against tremendous odds without having gained more terrain, then a halt was ordered.

I felt depressed when I learned of what I believed to be a vain sacrifice of human lives. Imagine my surprise when I noted much jubilation at Sacramento. Then I learned that we had succeeded in drawing so many enemy forces to our sector, where they were led to believe was to be launched the main assault, that the two divisions straddling the railroad had made a dent of nearly 6 smiles without great loss and were already having the engineers at work repairing the railroad and even building branches.

This three-day battle cost us over 600 dead, 1,300 slightly wounded and about 2,000 seriously wounded (including 210 wounded prisoners).

The mobile hospital had taken care of all emergency work, and had evacuated nearly 50 per cent of its inmates to Tana, where only four immobile field hospitals are functioning.

To be exact, a check at our office shows:

At dressing stations: 1,300 slightly wounded.
At mobile field hospital: 182 severely wounded.
At Tana: 1,818 severely wounded.

May 28.—Doubtless for strategic reasons neither our own nor the two flanking divisions of our army crops had been fighting since the 20th. Nevertheless there were occasional night attacks by our outposts. as they were anxious to capture the enemy sentinels.

The aid station reported this a. m. to have evacuated to the regiments practically all slightly wounded cases. Only four developed suppurating wounds and were evacuated to Tana.

The mobile field hospital returned only eleven cases to the front, six died, and the rest were sent to Tana. The C. O. of hospitalization reports that he is ready to evacuate to Zagora 500 patients. Nineteen have died. Only forty-two have been returned to the front. The rest are convalescing.

Twelve hundred replacements arrived at Sacramento and were distributed among the regiments.

August 16.—Since my last entry torrential rains have prevented extensive activities on our part. The enemy, too, has been quiet. We have had a slight endemic of intestinal trouble, but this was easily controlled.

Today activities have been resumed. The situation is about as it was, with this difference, that the 49th Infantry has occupied the position of the 67th Infantry.

Late in the afternoon the enemy posted machine guns on hill tops and had them so well camouflaged that our field artillery could not locate them, with the result

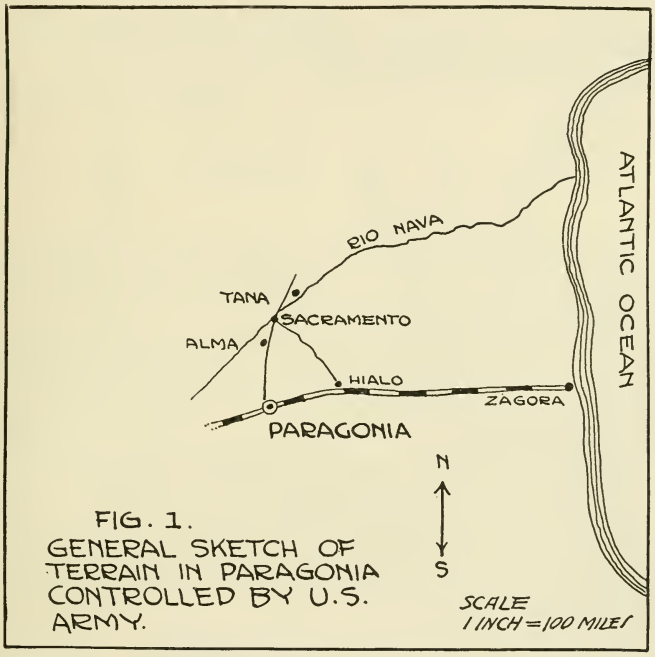


FIG. 1.
GENERAL SKETCH OF TERRAIN IN PARAGONIA CONTROLLED BY U.S. ARMY.

that our front lines were nearly wiped out. The infantry was ordered to retreat to the trenches north of Alma.

Though we left many dead on the battlefield, the retreat was completed in perfect order. Practically all wounded were littered back. Only a small number fell in the hands of the enemy. Colonel Worth at once ordered a section from Tana to the Onaga distillery. By 7 p. m. the section was functioning. F. H. 62 is filled. Tana has received 416 cases by midnight. Colonel Worth has gone to the front.

August 17.—Fighting was resumed at 4 a. m. By noon Alma was again in our possession. We took over 3,000 prisoners; 216 among them slightly and 47 seriously wounded.

Our casualties amount to 612—about 150 severely wounded among them. Additional howitzers arrived today. It is promised that we shall push forward from now on. The entire hospitalization has been moved to Sacramento. The mobile field hospital goes to Alma early tomorrow. The dressing station is to be in a farmhouse 2 miles south of Alma.

September 9.—We are now in possesion of the innermost forts. Paragonia city is but 3 miles distant. Our patrols say that no troops are visible between our lines and the capital city.

For the last few weeks fighting has been ceaseless. In spite of this our hospitalization scheme has worked out well. Only for a few days the number of severely wounded exceeded our total tent capacity by about 700. This was overcome by utilizing the houses of villages and by organizing a visiting medical service.

As the war seems ended I can now sum up our total casualties since the beginning of the fighting.

Killed.....	8,200	Of these died.....	410
Slightly wounded...	11,270	Returned to duty...	12,850
Severely wounded..	9,000	Evacuated base.....	4,200
Total wounded...	20,270		17,460

Of the 2,810 still hospitalized, only four are expected to die; 2,000 will be taken to the capital within a week. The rest will require hospitalization for about three weeks, and as they are not likely to get completely well for months to come will then be evacuated to the base at Zagora.

September 21.—Our triumphal entry into the capital proved a rather tame affair. We knew we had captured the rear-guard units, but if we expected the President and his cabinet and staff to hail us as his conquerors we were disappointed. Only the burgomaster of the city appeared to turn over the "Reyes" to the commanding general; that is what we learned when our division reached the parade ground near the presidential palace.

The government and the intact part of the entire enemy forces had made a successful retreat to the south and southwest—exact whereabouts unknown.

A day later we heard that Washington ordered a continuation of the campaign until the army was beaten and the civil authorities captured.

To my great disappointment I learned that our division was, for the present at least, to garrison the capital. Colonel Worth was transferred as corps surgeon of the 3d Army Corps, which consisted of the 9th (Regular), 37th (National Guard) and 102 (Volunteer) divisions.

But my gloom was rapidly dispelled when I learned that I had been previously promoted and was to accompany the colonel to corps headquarters, which was beginning reorganization in the capital.

The third corps was to lead the march south. It was to be commanded by Lieutenant General Hardy whom, rumor had it, the War Department could deny nothing he asked for.

General Hardy, I soon learned, heartily disliked our system of brigading. "A brigade consisting of two regiments of infantry is no brigade at all, and if you insist on this, such a brigade should be commanded by a senior colonel—but not by a general."

"A brigade should be a fighting unit, consisting of three regiments of infantry, of artillery and the necessary detachments of technical troops." This, it is said, is what he demanded of the War Department and what he was granted.

He was reorganizing his three divisions on the new basis proposed by him and even intended to place a brigade surgeon on the staff of each brigade commander, for which purpose he asked Colonel Worth for a conference.

The corps surgeon pointed out that there is absolutely no place in his scheme for brigade surgeons, that each division surgeon has sufficient liasion between the regimental medical officers and field sanitary units, and that each medical officer must have work and hard work and responsibility, while a medical adviser to a brigade commander would be a mere decorative officer.

Colonel Worth's ideas were concurred in.

I do not know yet what my particular work will be like. Colonel Worth is not enthusiastic over his appointment as corps surgeon, feeling that he would have little to do beyond collecting casualty reports. Meanwhile he is supervising the supply of all units of the corps.

An ambulance company and a mobile field hospital are added to Corps Headquarters. Colonel Worth intends to use them wherever needed. I am to be attending surgeon to Corps Headquarters, adjutant and general factotum to Colonel Worth.

October 5.—Our aviators and intelligence service have located the enemy. The government has set up its headquarters at Tortillas, an inland city, 160 miles south of the capital. The entire Paragonian army, after having destroyed as much of the railroad as it could during its flight, has entrenched in three systems to protect the approaces to the temporary "capital."

Colonel Worth tells me that the corps is destined to bear the first brunt of the campaign. Several divisions are already engaged in the task of guarding the railroad engineer regiments which are repairing the destroyed railroads.

The base hospitals at Zagora now function as embarkation hospitals. Paragonia city will be our advanced base. The chief surgeon of the oversea forces has already established his headquarters there and was turning castles, public buildings and regimental barracks into base hospitals.

The terrain south of the capital, with the exception of a chain of high hills within 10 miles from the capital, is practically even.

As the corps will not leave the capital for about a week, Colonel Worth has summoned his three division surgeons and has instructed them to hold daily school for all medical officers, especially the regimental surgeons.

The latter have been ordered to drill their detachments and the regimental musicians in the proper manner of approaching the wounded under fire—a method resembling infantry rushes. As I have many clerical labors to complete I cannot go to see these drills, much to my regret.

October 16.—Corps Headquarters is leaving today for the new front.

October 18.—We arrive at Tortugas, a miserable village. An old stable is the only available place for Colonel Worth's office. I am to accompany him tomorrow to inspect the 102d Division. I learn that the strategic plan is simplicity itself. The distance from corps headquarters to Tortillas is approximately 80 miles. A good road runs parallel to the railroad connecting the two points. There is no river with potable water in the terrain to be occupied. A water train will ply between Paragonia city and the occupied terrain. For the rest, dependence must be had on the wells used by the civilian population, after analysis by special details, which accompany every division.

The front will extend about three miles to the right and three miles to the left of the railroad, as the marshy terrain further on prevents flanking movements by

either side. While enveloping movements on a small scale will be attempted by individual regiments, the principal fighting will be frontal in character. The enemy is strongly entrenched at Moras, Pueblo and Matesa, having developed trench systems extending from five to eight miles in depth. These trench systems will have to be taken.

November 1.—Our corps has taken position a mile north of the foremost enemy trenches at Moras.

Artillery fire began at 6 a. m. and lasted until 10 a. m. Five minutes later our infantry swept over the first-line trenches and attacked the second-line trenches with hand grenades. The enemy in large force attempted a sortie, and a bayonet mêlée ensued. We took the second-line trenches and stopped further advance owing to heavy bombardment by enemy artillery.

The center division (102d) suffered most. The regimental litter bearers, however, had approached the wounded, had rendered first aid and collected them in trenches. The regimental aid stations were moved there by 5 p. m. At 7 p. m. 240 wounded (severely) were littered back to the rear of the ambulance park, whence they were conveyed to the 102d mobile F. H. The divisional immobilized field hospitals at Saltillo remained idle. The 9th and 37th divisions at 10 p. m. reported a total of 309 severely wounded. The 9th had pitched a mobile F.H. in the woods and succeeded in getting all its severely wounded to it before midnight.

Colonel Worth directed me to report to the division surgeon of the 9th Division as "liaison officer."

November 2.—I spent the entire day with the 9th Division. Practically the entire trench system was gained in three hours fighting after a preliminary bombardment. The enemy withdrew in great haste and left many dead and wounded in the trenches.

The division lost 310 killed, 810 wounded. I accompanied the center regiment and saw that the regimental surgeons kept all slightly wounded and the gravely shocked cases in the trenches. All transportation began at nightfall. A few men venturing out in daylight drew heavy shrapnel fire. The mobile field hospital was acting as an assortment station, the dressing station being busy with the slightly wounded cases, of whom there were several hundred. The division surgeon directed 30 ambulances to proceed to the mobile F. H. One hundred and twenty severely wounded were loaded and taken to Saltillo, which by now had 15 immobilized field hospitals. They came back in three hours and took away the remaining cases to be transported. I went with the last ambulance to Saltillo and found there Colonel Worth, to whom I reported.

General Hardy had moved into Saltillo. There was to be no fighting tomorrow. I worked in one of the immobilized field hospitals until 6 a. m., principally giving anesthetics. At 7 a. m. I went to sleep.

November 6.—There has been a good deal of fighting in the open. The nights are bitter cold. Today we had the first snow. The Paragonians are fighting from ambush a good deal, but even that did not stop our advance. We have occupied Zapatas, a mere compound of ramshackle huts. The regimental bearers are searching the ground for wounded until late in the night, using lanterns which are so constructed as to hide the light from the enemy.

I am to go in the morning with a train on which 400 wounded are to be evacuated to Paragonia City. The same train is to bring back a number of canvas strips with handles. Colonel Worth wants no litters on the battlefield, as some of our litter bearers in the 37th Division have been wounded. I a lso to bring a number of

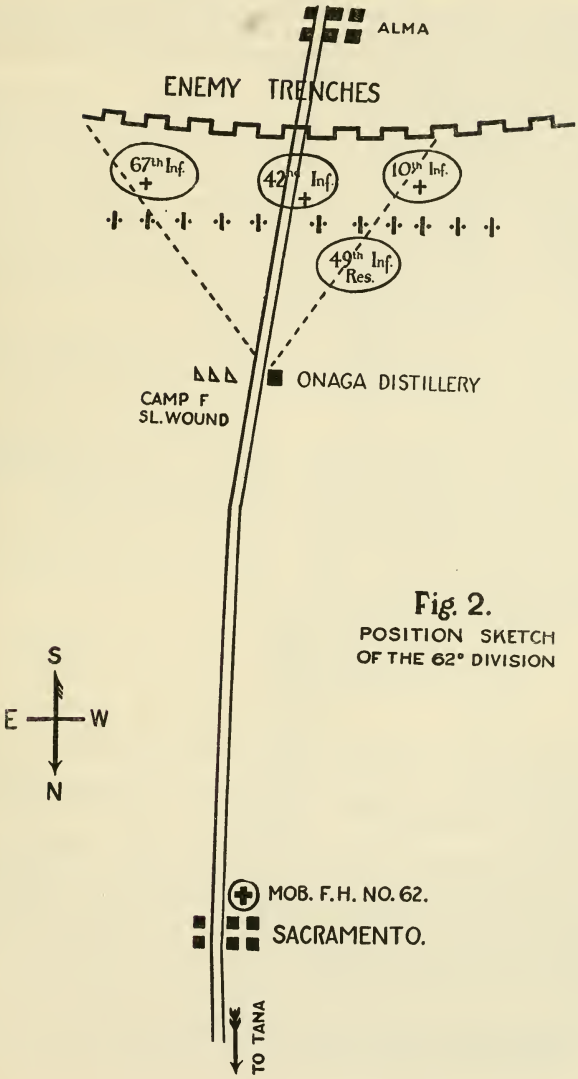


Fig. 2.
POSITION SKETCH
OF THE 62° DIVISION

tent heaters. I understand today that, if the Pueblo trench system will stand our attacks no better than Moras, the corps hospitalization will be concentrated at Mujer, which is supposed to have certain facilities, there being a large cheese factory and a distillery, which will be utilized.

Norember 22.—The entire Pueblo system has been stormed. I did not see very much today as the C. O. of the 9th Div. Ambulance battalion has been wounded and I was ordered to take his place. From 1 until 4 p. m. I have been assorting the wounded, about 300. I pitched eight small tents and collected 92 slightly wounded but these could accommodate only 56 patients. A haystack in the vicinity was requisitioned and the least injured made comfortable. An ambulance brought me 100 blankets. The men were inspected several times during the night and seemed comfortable. At 5 a. m. we served hot coffee and a light breakfast. By 7 we had redressed all who slept in the hay, and as the sun was now out in full glory the men themselves begged to be returned to the front. Two had wrist wounds of the right hand. I evacuated them to the hospitalization center.

December 18.—We are marching in Tortillas streets. The enemy has surrendered unconditionally. Our corps has now its headquarters in the temporary capital. Washington is sending peace plenipotentiaries. I am again with Colonel Worth, who has just been promoted temporary brigadier general. A pair of new gold leaves fill my heart with joy.

I have seen too little of the last and final fighting to give a detailed account of the fall of the Matesa trench sector. But I am at work in General Worth's office collecting and tabulating the field reports. By them I can plainly see that if we ignore small variations the battles have shown approximately the same result.

Taking each division of the corps as a unit, we find that the figures do not fluctuate to any great extent.

General Hardy's divisions, of course, differed from the 62nd Division in their numerical makeup.

The 9th, 37th and 102d divisions each had:

2 brigades of 3 infantry regiments	18,000
Artillery and small detachments	1,200
Total	19,200

Of these he never had in action more than four regiments plus artillery, keeping two regiments in reserve.

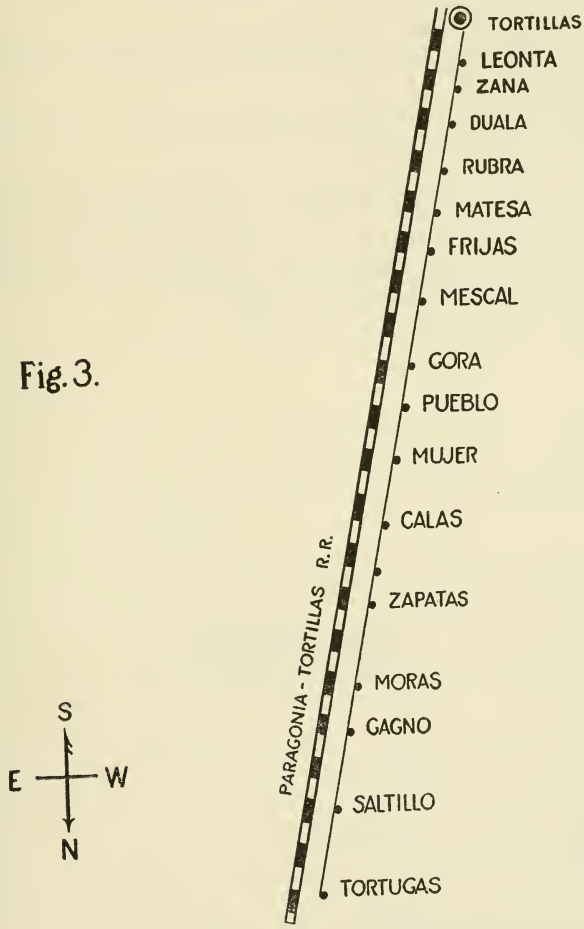
The casualties throughout the entire campaign in the south for each division averaged per principal battle day: Slightly wounded, 8,230; severely wounded, 1,114.

Battles seldom exceeded three days of hard or mass fighting. At the conclusion of the last battle (Matesa) which lasted five days, there was an average of 5,200 for each of the three divisions needing prolonged hospitalization. The mobile field hospitals sent daily approximately 200 patients to the immobilized field hospitals and still could take care of 100 patients who could not be transported. The immoblized field hospitals proved ample for every battle, as within three days, room was always provided through deaths, evacuation to the front and evacuation to the base.

I am now forced to acknowledge that General Worth's ideas were right. He has shown that:

1. The system of the care of battle casualties should be as simple as possible, viz., regimental aid stations, one for each regiment, a principal dressing station, ambulance park and camp for slightly wounded combined, which is to check the

Fig. 3.



flow of slightly wounded and regulate evacuation to the rear, opportunity for surgery close to the front to reduce the time and danger incident to prolonged transportation (mobile field hospital) and temporary hospitalization at not too great a

distance for all cases not requiring emergency operations (immobilized field hospitals).

2. The need of evacuation hospitals where railroad facilities are available has been shown not to exist.

3. Reduction of medical officers. In the absence of evacuation hospitals, even though the field hospitals need more medical officers now, there is still a fairly large number available which heretofore has been held up to comply with the Tables of Organization.

4. Elasticity. Each immobilized field hospital is really three mobile hospitals, easily separated and moved about and as easily held together as one hospitalization unit.

5. Centralization. The division surgeon, in combat, takes station with the principal dressing station and regulating point. That is his proper headquarters From there he can control the ambulance companies and hospitals. He is, thereby, the commander of all medical units. There really is not and should not be a "sanitary train," but a "divisional medical service" embracing: (1) Headquarters and staff; (2) regimental medical service; (3) ambulance battalion; (4) mobile field (surgical) hospital; (5) immobilized field hospitals.

THE TRANSMISSION OF THE PNEUMONIA PRODUCING GROUP OF ORGANISMS

By Lieut. Colonel JAMES G. CUMMING, *Medical Corps, U. S. A.*, and Captain CHARLES B. SPRUIT, *Medical Corps, U. S. A.*

THE pneumonia group of organisms as here considered include only those varieties which have been isolated from the blood stream of pneumonia patients. These varieties are the type pneumococci, the hemolytic streptococcus, and streptococcus viridans. In civil practice the type pneumococci are common causes of pneumonia. This is not so in the Army. But where lobar pneumonia does occur among troops it is most frequently complicated by a secondary invader, which prolongs the period of illness and is the immediate cause of death. Not only are the lobar pneumonias complicated by secondary invaders, but so also, and with great frequency, do the virus infections—measles, scarlet fever and influenza—prepare the soil for an invasion of lung tissue by secondary invaders which are harbored in the upper respiratory passages.

Since the pneumonia group of organisms ranks first as a cause of death among troops not only as a primary infection, but to a far greater degree as a complication of the virus infections, it became necessary to make epidemiological and laboratory studies in order that preventive measures might be instituted.

A clinical study of these complicating pneumonias made it apparent that organisms other than pneumococci were responsible for the infection, and the question arose as to why these highly fatal secondary pneumonias should be the predominant type in the army camps. To determine this point it was imperative that the causative organisms be first identified. Having in mind the occasional occurrence of hemolytic streptococcus complications in cases of scarlet fever in civil hospitals, and recognizing that measles, the disease with which we were mostly concerned, also belonged to the group of virus infections, it was decided to make a search for this organism. An investigation of throat swabs of measles patients upon entrance to the hospital, and of sputum, empyema pus, and particularly the blood of pneumonia cases, left no doubt but that the offender in cases of scarlet fever in civil hospitals was now chiefly responsible for the heavy toll in post-measles pneumonia deaths in the Army. [1]

Why should this organism prevail in the tonsil to the extent of 36 per cent among all measles patients upon entrance to the hospital—

[1] Cumming, Spruit and Aten, "Streptococcus Pneumonia." *Journal American Med. Asso.* March 8, 1918.

33 per cent of whom developed pneumonia—while in the civil population the carrier state and the post-measles pneumonia rate are comparatively low? There was evidently some sanitary defect responsible for the wide dissemination of the virus infections and the complicating hemolytic streptococcus in the army camps.

As early as the fall of 1917 our observations at Camp Tanforan, California, led us to suspect that the old line method of washing messkits in warm water was a faulty mess hall detail, leading to a wide distribution of mouth organisms.

During the winter of 1917–1918 in San Antonio we made further observations on the temperature and bacterial count of messkit wash water. It was not, however, until the influenza epidemic of September, 1918, that our epidemiological investigations at Newport News gave a practical demonstration of the importance of using only boiling water for washing messkits.

Among 66,000 troops it was shown that the use of tableware or messkits, which were washed in boiling water, had a marked influence in reducing the incidence of influenza and pneumonia, whereas the washing of messkits in warm water only resulted in five times more influenza cases and pneumonia deaths.[2]

In comparing the influenza-pneumonia death rate of the Army as a whole with this rate in the civil population, it is found that there were almost three times more deaths in the Army. This increased mortality in the Army was attributed to overcrowding, fatigue, age susceptibility, etc., but we maintain that our studies show these factors to be but of minor importance in the production of disease. In the large groups of soldiers which we studied there was no difference in age, fatigue, crowding, clothing, etc., and yet the influenza morbidity and pneumonia mortality were five times greater in the one group—that group which used lukewarm water for washing messkits.

It may be granted that there are many subsidiary factors in the production of diseases, but let us not overlook the one fundamental law for all acute infections, *i. e.*, that the introduction of the causative organism is essential to disease production and that the avenue of transmission of the various diseases should be very definite for each group, sputum, intestinal, and insect-borne.

Our study of pneumonia carriers was undertaken for the purpose of determining, first, the major and minor avenues of distribution of the "so-called" respiratory infections; second, to devise means whereby these avenues, according to their importance, might be blocked.

[2] Lynch and Cumming, "The Distributionof Influenza by Indirect Contact—Hands and Eating Utensils." *Am. Jour. Public Health*, January, 1919.

It may be said that the pneumonias, the virus infections, influenza, measles, etc., as well as diphtheria and meningitis, have heretofore been classed as respiratory diseases. Our studies, however, show the fallacy of this terminology and indicate that they should be more properly called *sputum-borne* infections.

BACTERIOLOGIC STUDIES OF THE AVENUES OF DISTRIBUTION

The following laboratory studies include the isolation and identification of organisms of sputum-borne infections from eating utensil wash water, from hands, inanimate objects, and from air and floor dust. Both carriers and cases were used as sources of infection in this series of studies, and dust was secured from wards occupied by streptococcus cases.

Eating Utensil Wash Water.—In order to determine the prevalence of the organisms of the sputum-borne infections on eating utensils, the following procedure was carried out. All dishes and silverware were steam sterilized before they were used by those patients under investigation. After the mess each set of utensils was placed in a separate sterile container and brought to the laboratory. Here each set was washed in sterile warm water. The wash water was then examined in accordance with standard laboratory methods for the organisms in question. No attempt was made to type the pneumococci in this set of experiments.

It will be noted in Table I that streptococcus hemolyticus was isolated from 84 per cent of the wash water specimens, pneumococci from 63 per cent, streptococcus viridans from 65 per cent, and *B. diphtheria* from 2 per cent of the specimens.

TABLE I.—*Percentages of Positive Findings in the Examination of Eating Utensil Wash Water.*

	Total	Positive	Negative	Per cent positive
Streptococcus hemolyticus	32	27	5	84
Pneumococcus	16	10	6	63
Streptococcus viridans	32	21	11	65.6
B. diphtheria	156	3	153	1.9

Attention is here called to the fact that in public eating places where hand washing of dishes is practiced, the dishes may be more highly contaminated after than before they are washed. In some restaurants about 60 per cent of the organisms are removed, whereas, when machine washing with boiling water is carried out, 99 per cent of the organisms are removed.

In a recent report it was shown that the use of machine-washed dishes is an important factor in the control of influenza-pneumonia.[3] The conclusion of this epidemiological report is here amply supported by the laboratory findings.

It will be recognized that eating utensils come in direct contact with the oral cavity. They are contaminated, partially washed in warm water, and introduced into the mouths of others. This surely spells infection. There is no more common avenue of sputum-borne disease distribution than through eating utensils, and the corrective measure lies in the simple process of using boiling water as a pasteurizing agent.

Hands.—The hands have long been suspected as the transmitting agent of the intestinal-borne infections. This is especially so in the case of food handlers. If the hands become contaminated with intestinal organisms, how much greater is the possibility of hand contamination in the case of sputum-borne infections! A casual observer will recognize with what frequency the hand visits the mouth and nose. This habit results in unquestionable hand contamination.

In order to determine the prevalence of hand contamination, the hands of cases and carriers were examined for pathogenic organisms. In the case of those infected with the pneumonia group of organisms, the balls of the fingers were rolled on the surface of 10 per cent horse blood agar plates, and, after twenty-four hours' incubation, colonies were picked and identified. By the same technical procedure, *B. diphtheria* was first obtained on plates of Leoffler's blood serum, but later a media developed by Capt. J. W. Cox, M. C., and consisting of azolitmin, Andrade dextrine plates, was exclusively used with better results. In this series of experiments, as in the former, the balls of the fingers were rolled on the surface of the plates. These were incubated; suspicious colonies were then transferred to Loeffler's blood serum tubes for identification.

In Table II the number of examinations and the percentage of positive findings are given. Streptococcus hemolyticus was found in 38 per cent of the specimens, pneumococci in 17 per cent, streptococcus viridans in 100 per cent, and *B. diphtheria in* 5 per cent. In this series of tests four Type I and three Type IV pneumococci were isolated. It is to be noted that those organisms, which grow on selective media with a distinctive type of colony, give the highest percentage of positive results. In the case of diphtheria, the difficulty of colony identification was doubtless responsible for the low percentage of positive results. When, however, the Cox differential plate was adopted, this

[3] Cumming, James G., "Influenza-Pneumonia in 370 Public Institutions as Influenced by Dish Washing." In press, *American Journal Public Health.*

percentage was increased. It is interesting to note that plates from the hands of several cases gave almost pure cultures of Kleb-Loeffler bacilli.

TABLE II.—*Percentages of Positive Findings in the Examination of Hands.*

	Total	Positive	Negative	Per cent positive
Streptococcus hemolyticus	340	125	215	38
Pneumococcus	41	7	34	17
Streptococcus viridans	8	8	0	100
B. diphtheria	144	8	136	5.5
B. tuberculosis	55	1	0	1.8

The high percentage of positive findings is wholly within the bounds of theoretical assumption. This is especially so in the case of those organisms, which are easily identified. It will be noted that the percentage from contaminated hands is not as great as eating-utensil wash water. The hands of cases and carriers are not, except under special circumstances as in the case of dentistry, introduced in the mouths of other persons, as are eating utensils. But the hands do contaminate inanimate objects, and these may be sources of transmission to others.

In contrast to the transmission by the hand route, it will be recognized that the highly contaminated eating utensil, which is not pasteurized, introduces infection with facility to others.

Inanimate Object Conveyors.—We all, during a single day, handle or touch many inanimate objects, which have been handled or touched by one or even a thousand individuals. It was with this point in mind that we examined inanimate objects with the view of determining the percentage contaminated with pathogenic organisms.

Inanimate objects in close contact to, or handled by, cases and carriers were the objects of investigation. These objects consisted of bedside table tops, bed posts, handles of sputum cups, and door knobs. In the isolation of the hemolytic streptococcus, sterile gloves were wiped over the object and then streaked on blood agar plates. The same technical procedure was followed with *B. diphtheria*, but the streaks were made on the Cox differential plates. In the examination for the pneumococcus, the object was mopped with a sterile swab moistened in bouillon. After thoroughly rinsing the swab in bouillon, cultures were made in deep 10 per cent horse blood agar plates, and after incubation suspicious colonies were identified.

In Table III is given the number of examinations and the per-

centage of positive specimens. The hemolytic streptococcus was isolated from 13 per cent of the specimens, the pneumococcus from 50 per cent, streptococcus viridans from 26 per cent and *B. diphtheria* from 3 per cent. Of those strains of pneumococci which were typed the following were demonstrated: Two Type I and one Type IV from bedside table tops; two Type IV from door knobs, one Type I from a cup handle.

TABLE III.—*Percentages of Positive Findings in the Examination of Inanimate Objects*

	Total	Positive	Negative	Per cent positive
Streptococcus hemolyticus	61	8	53	13
Pneumococcus	14	7	7	50
Streptococcus viridans	45	12	33	26.6
Diphtheria	184	5	179	2.7

It will be noted that the percentage of positive findings from inanimate objects is less than from the hands, and as already shown the contamination of the hands is less than eating utensils.

Floor and Air Dust.—In making a study of the possibility of transmission of pathogenic organisms through the air route of travel, we considered it important to make a sharp distinction between air and floor dust. Could floor dust be heavily ladened with bacteria, while the air we breathe—5 to 6 feet above the floor—be practically free?

In carrying out this series of tests, wards occupied by measles and pneumonia patients were examined for hemolytic streptococci. In the examination of floor dust, the procedure was to collect the sweepings from a considerable number of small floor areas. These sweepings were suspended in sterile salt solution in the proportion of 1 to 10, and plated in deep 10 per cent horse blood agar.

In a series of twelve examinations of dust from approximately one square foot of floor area, there was an average of 13 hemolytic streptococci per square inch. In eight additional examinations the colonies were too numerous to count. In another series of seven tests sweepings were collected from given areas of 324 square inches, and it was calculated that there was one hemolytic streptococcus per square inch of floor spaces. The above tests were made on measles wards, and it will be noted that streptococci were present in sufficient numbers to be easily demonstrated. On the pneumonia wards there were 39 examinations, 25 of which were positive for hemolytic streptococci.

Air Dust.—If the air-borne route of distribution is important as an avenue of sputum-borne disease transmission, it should be possible to isolate pathogenic organisms from the air with marked regularity. As cubicling and masking were resorted to as a means of preventing respiratory diseases—especially measles and influenza—and their complicating pneumonias, it was decided to devote our attention to the isolation of the hemolytic streptococcus. This organism, especially in the army camps, was the most common cause of the secondary pneumonias, and in addition there are no technical difficulties in its identification.

These air dust examinations were carried out on wards occupied by hemolytic streptococcus carriers or cases. The air was drawn through sterile salt solution by either a hand pump or by a water suction pump. The volume of air washed by the hand pump was determined by the water displacement method. The volume washed by the suction pump was calculated by determining the time required to evacuate a large collapsible bag of known air volume. Having this as a known factor, the total volume of air washed was easily calculated.

There are shown in Table IV the air volume, the height of intake, the total bacterial counts, and hemolytic streptococcus findings. It will be noted that the height of the intake from the floor is the deciding factor, not only as to the total bacterial count, but also as to the presence or absence of hemolytic streptococci. While there are 214 organisms per liter of air at a height of 2 inches and one organism per liter at 2 feet, there is only one organism per 2,000 liters at a height of 5½ feet, equal in volume to three hours of respiratory air. But the most striking result is the total absence of hemolytic streptococci at a height of 2 feet or more.

TABLE IV.—*Bacterial Count per Liter of Air.*

Volume of air		Bacterial count total	Hemolytic streptococci
1.4 liters	2″ from floor.....	300 per liter of air..	35 (estimated)
2.8 liters	2′ from floor.....	17 per liter of air..	0
4.2 liters	2′ from floor.....	14 per liter of air..	0
10 liters	2′ from floor.....	40 per liter of air..	0
10 liters	2′ from floor.....	30 per liter of air..	0
10 liters	2′ from floor.....	50 per liter of air..	0
11,000 liters	5′ 6″ from floor.....	2 per liter of air..	0
14,000 liters	5′ from floor.....	3 per liter of air..	0
11,000 liters	5′ 6″ from floor.....	10 per liter of air..	0
11,000 liters	5′ 6″ from floor.....	10 per liter of air..	0

These experiments were conducted on "streptococcus wards" in which all the beds were occupied by patients, who coughed considerably. The results of these tests show the remote possibility of infection through the air route. In addition, reference may be made to a former report in which it was shown that droplets expelled by an act of coughing or by an atomizer have not only a rapid rate of fall, but also a high dilution in the air.[4] From these findings it appears that in order to transmit infection by droplets it is necessary for one to cough directly into the face of another. I have never seen this occur in an army camp, although close observations have been made. It is an injustice to the American soldier to say that droplet infection was responsible for the high disease incidence. These men respect good manners. Let us not make the mistake of unjustly blaming the individual, for the high disease incidence was due to what may be termed mass, or collective sanitation, over which the individual had no direct control.

In Table V there is shown comparative data for the three main avenues of contagion transmission. A perusal of the percentages as here presented indicate the relative importance of the routes of distribution.

TABLE V.—*Consolidated data.*

	Dishes, per cent	Hands, per cent	Inanimate objects per cent
Streptococcus hemolyticus	84	38	13
Pneumococcus	63	17	50
Streptococcus viridans	65.6	100	26.6
B. diphtheria	1.9	5.5	2.7
B. tuberculosis	.....	1.8	.....

THE CARRIER RATE IN SELECTED GROUPS AS DETERMINED BY MESSING CONDITIONS.

In our foregoing considerations of the several avenues of sputum-borne disease distribution, it appears that the avenue of greatest danger is at the mess. If this is so, it should be possible on a basis of messing conditions to secure corroborative evidence by a determination of the carrier rate in selected groups.

In Table V there is presented the percentages of hemolytic streptococci carriers for seven civilian and soldier groups. These differ according to age, the kind of eating utensil used, the size of the messing group, and the temperature of the eating utensil wash water.

[4] Lynch and Cumming, "Epidemiology of Influenza-Pneumonia." In Press—Modern Clinical and Laboratory Medicine.

TABLE VI.—*The Hemolytic Streptococcus Carrier Rate in Selected Groups.*

	Per cent
158 civilian children, 6 years old, used tableware	0
164 civilians, age 14 to 17 years, used tableware	1.2
102 Malarial Drainage Detachment, used messkits washed in boiling water	5.8
216 average civilian adults, used tableware, average family groups	6.0
229 Hdqrs. Detachment, used tableware, a common mess	12.0
207 Shipyard's office force, used tableware, a common mess	20.7
422 Troops, used messkits washed in warm water	32.0

It will be noted that while no carriers were found among average children, 6 years of age, there was a carrier rate of 1.2 per cent among those 14 to 17 years of age, and that the civilian adult carrier rate was 6 per cent. In spite of the fact that all these age groups eat from tableware, there is a marked difference in the carrier rate. There should then be a difference in the influenza-pneumonia death rates for these age groups. Official records show this to be so, the rate in civilian children being lower than in civilian adults. In our recent epidemiological study of influenza-pneumonia it was found that the mortality among institutional children was several times greater than among civilian children. In institutions there is a common mess; consequently there should be a high carrier rate and a high mortality rate. In this connection it would be interesting to know the actual carrier rate among institutional children so that comparison may be made with the rate among civilian children.

The several age classes among civilians eat in small family groups of approximately four individuals each, and as the carrier rate in average civilian adults is approximately 5 per cent, there is but one carrier among five such families. So long as the individual eats within his own family group, as in the case of children, the chances of acquiring the carrier state is not great. But as the age increases, so also the activities of the individual increase, so the opportunities of infection are expanded to include promiscuous messing in other family groups, and in public eating places where eating utensils are only handwashed with no thought of sterilization. The difference in the percentage of carriers in the several age groups is, then, influenced by the age and the duration of and degree of exposure.

In regard to the prevalence of the streptococcus carrier state among average troops it may be said that in the late fall of 1917 the carrier rate for 400 troops at San Antonio was 5.5 per cent. In contrast to this rate we find, as shown in Table V, that among 422 troops examined during January and February 1919, the carrier rate was 32 per cent. Each of the above groups of soldiers belonged to four different organizations, so the results of the total examinations may be taken as a fair

representation of the average carrier rate. Why should the hemolytic streptococcus carrier rate among soldiers increase five times within about one year? It is believed that the answer to this question is shown in Table V. It will be noted that the Malarial Drainage Detachment had a carrier rate of 5.8 per cent. The soldiers in this detachment, as all others here investigated, had been in the service over one year, and all the percentages, including those for civilian groups, show the results of investigations during January and February of 1919. In contrast to the low percentage of the Malarial Drainage Detachment, where boiling water was used for washing messkits from the time of the detachment's formation, it is found that for average troops the rate is 32 per cent. These average troops used the old line method of washing messkits in warm water. In contrast to these two groups, both of which used messkits, it is worthy of note that the Headquarters Detachment, which uses tableware, had a 12 per cent carrier rate. Why should this rate be higher than the Drainage Detachment, and lower than average troops? There was in the Headquarters Detachment promiscuous messing—a large messing group, a few carriers as the original foci and distribution to others through partially washed eating utensils. On the basis of the facility of transmission of the sputum-borne diseases at the mess, one would not anticipate as high a percentage of carriers among troops eating from tableware as among those eating from messkits washed by the old line method. When tableware is used there is only one avenue of spread—through the eating utensil; whereas when messkits are used there are two routes of travel—through the hands and messkits.

In conclusion attention is called to an army group and a civilian group, both of which ate from tableware. As shown in Table V, Headquarters Detachment had a carrier rate of 12 per cent, while the office force at the shipyard had a rate of 20.7 per cent. The detachment had been in existence one year, and although there had been promiscuous messing three times daily, the opportunity of transmission at the mess had been eliminated by the use of boiling messkit wash water. On the other hand the employes at the shipyard had been exposed at a common mess, through the use of partially washed eating utensils, but once a day—the noon meal—for a period of from five to ten years. These office employes are a special group of civilians, who have a carrier rate five times greater than average civilian adults. In this connection it would be of interest to determine whether or not other selected groups of civilians, who habitually eat their noon meal at public eating places, have a similar high streptococcus carrier rate.

The laboratory researches of the several avenues of contagion dis-

tribution show the importance of blocking that major avenue of distribution at the eating place by the use of boiling water in the process of washing eating utensils. The researches into the prevalence of carriers in selected groups, on a basis of messing conditions, support our finding as to the importance of preventing the distribution of the sputum-borne diseases through eating utensils which are washed in warm water.

It should be appreciated that there is more promiscuous messing now than ever before; consequently there will be an increased pneumonia carrier rate. As a result of this increasing carrier rate, it is to be pointed out that in the event of a future influenza pandemic there will be an even greater mortality from the complicating pneumonias than there was in the recent pandemic. As a public health measure the investigations here reported indicate the necessity of blocking transmission of the sputum-borne infections at eating places. It is our belief that the intensification of this single measure will accomplish greater prevention than all other measures combined.

DEDUCTIONS

1. The streptococcus carrier rate is many times greater among average troops than among average civilians. The pneumonia and other complications of the virus infections are greater in the Army than in civil populations, and among troops this is due to the high carrier rate of the group of pneumonia producing organisms.

2. This high carrier rate was not due to crowding in barracks but to insanitary messkit washing incident to crowd messing.

3. The dangers incident to crowd messing can be eliminated by the use of boiling water for the washing of eating utensils.

4. Environment is a subsidiary cause of disease production. Blocking the avenues of transmission, thereby preventing infection in susceptibles as well as in immunes, is the crux of control.

5. The institution of the control methods applicable to the prevention of pneumonia will automatically control the virus infections.

6. In order of importance the eating utensil appears to be foremost as a distributing agent of the sputum-borne diseases,the hands ranking second, the inanimate object third, and the air fourth.

7. Laboratory researches, as well as epidemiological investigation in the Army and public institutions, indicate that the greatest possibility of sputum-borne transmission occurs at the mess—contaminated hands and messkits in the Army and partially washed eating utensils in public institutions, as well as in public eating places and the home. There-

fore, the asepsis of eating utensils in the Army, in public eating places and in the home appears to be of greatest importance in sputum-borne disease prevention.

8. In the prevention of sputum-borne epidemics it is indicated, on the basis of "the theory of case and source elimination," that the universal application of the principle of eating-utensil pasteurization—thereby blocking the major avenue of distribution—will accomplish the desired end.

SOME OBSERVATIONS ON THE USE OF VACCINES AND GLUCOSE IN THE TREATMENT OF INFLUENZA AND BRONCHO-PNEUMONIA[1]

By H. H. KOONS, M. D.

MUCH has been written and justly claimed for the use of vaccines in the prevention of disease, but comparatively little has been claimed for them in treatment. The consensus of opinion of unprejudiced observers is that they have a distinct value as a prophylactic measure in influenza and its allied pneumonia, and beyond a doubt confer immunity for a variable and undetermined length of time. The period of immunity must necessarily be of short duration owing to the fact that the disease itself protects the patient from a second attack, in many instances, but a short time. No more could be expected of a vaccine. A physician or nurse constantly exposed to contagion during an epidemic should have a prophylactic dose at short intervals—from six to eight weeks.

What I wish especially to call attention to in this paper is the use of vaccines in the treatment of broncho-pneumonia, for I am convinced that their value is of extreme importance in this field and that they are by far the greatest life-saving factors of which I have any knowledge.

During the pandemic of 1918 I was on duty in Base Hospital No. 1, of the Southern Department, at Fort Sam Houston, Texas. In a department base hospital a large percentage of your patients come in from camp hospitals and infirmaries with the disease well established, and the problem confronting the internist is a difficult one. Only those who have seen ward after ward jammed with these desperately sick men know what an appalling sight it is, and the feeling of utter helplessness of the physician responsible for the lives of these men is beyond expression. During the epidemic I had charge of from three to five wards full of influenza and pneumonia patients and had ample opportunity to observe and study the various phases of the disease and the different methods of treatment, and my conclusions are that the most valuable aids we have are vaccines and the intravenous use of glucose.

In spite of much adverse criticism and little praise for glucose, I have become a firm believer in its efficacy, having used it hundreds of times with beneficial effects, and have seen desperate cases apparently saved by its use.

In serious cases of shock or exhaustion, following injury or operation or serious illness, glucose is invaluable.

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[1] Read at the Los Angeles County Medical Society, February 5, 1920.

Having studied and experimented with vaccines for a number of years and demonstrated to my satisfaction their usefulness, I have also learned much of their limitations and do not expect the miraculous results often promised by over-enthusiastic advocates. In my private practice I have used them for the past five years in the treatment of influenza and broncho-pneumonia with uniformly good results. But as they are not endorsed by the profession generally as remedial agents, I hesitated to use them in the army hospital at the beginning of this epidemic, and gave them at this time only to a few selected cases in which ordinary treatment was of no avail. As the good results were noted their use became more general, although they were never used routinely in my wards, but were given only after thorough examination and study of the patient and other than ordinary treatment seemed indicated.

Vaccines, as developed today, should not be looked upon as specifics but as valuable adjuncts to treatment. They are a powerful factor in limiting the extent of the infection, of hastening crisis, and an early convalescence, and at the same time very materially lessen the number of serious sequela so frequent in this epidemic (empyema, phlebitis, neuritis, sinusitis, ottitis media, and mastoid infection). In one hundred cases treated with vaccine there developed but one case of mastoid, one of phlebitis, and one case in which 420 c.c. sterile fluid was withdrawn from the chest. There was not one case of empyema, although we had as high as 18 per cent empyema in some of our pneumonia wards. I have given vaccines in very severe cases—those which do not respond to ordinary treatment; those which improve to a certain point and continue with a temperature ranging from 100 to 102° for days, without sufficient physical signs to justify their rise im temperature. In the majority of these last-mentioned cases where there is no demonstrable lesion, one injection of vaccine will bring the temperature down to normal within thirty-six hours, and it will remain normal. One reason that vaccines have been condemned in treatment is that men look for immediate results, failing to realize the fact that no improvement should be expected until the antibodies, elaborated in the system in response to the irritant, appear in the blood, and the clinical result is noted in thirty to thirty-six hours.

There is no rule of thumb in the administration of vaccines. The physician must study the case and use his judgment as to the vaccine to use, the dosage indicated and the proper time to give it. In adding toxins to an already toxic system the first result is, naturally, an increase in temperature and in the general toxic condition, and it is quite apparent how an over-dose might overwhelm a patient. The initial

dose must be very carefully estimated, gauged by the condition of the patient, based on temperature, pulse and respiration and general toxic condition. If given at his maximum temperature a very small dose will suffice to show reaction and raise temperature one-half to one degree. In the ordinary case of influenza and broncho-pneumonia, a marked drop in temperature, pulse and respiration may be expected within thirty-six hours after the initial dose, and subsequent doses must be gauged by reaction due to initial dose.

In hemolytic streptococcus pneumonia and in frank lobar pneumonia, especially in Type I, vaccines are less indicated but still have some value. Whether you class broncho-pneumonia as a mixed infection or not, the fact remains that, while you may find a single strain of infectious organism in lung puncture and assume it to be the exciting cause of the disease, the sputum in the same case will be swarming with a variety of pathogenic organisms, and it is reasonable to assume that they are doing their part toward the progress of the disease; and if we are able to counteract the toxic effect of any one or more of these infecting organisms, we are relieving the over-burdened system of that much of its load, and it may be sufficient to tide the patient over his critical stage. This is one answer to the men who condemn vaccines offhand on the ground that we are uncertain as to the specific organism causing the epidemic and can have no specific vaccine. When we confine ourselves to absolute specifics, the armamentarium and usefulness of the physician will be very limited.

In Type I pneumonia use the antipneumococcic serum Type I freely until you get results. In hemolytic streptococcus pneumonia use antistreptococcic serum incorporated in glucose solution, which is indicated in all these cases. In my wards glucose was given in 10 per cent solution, 250 c.c. intravenously as often as indicated. In many cases I have used it every six to eight hours for several days without noting any deleterious results other than a chill which frequently follows intravenous medication. This disagreeable occurrence may often be avoided by incorporating an eighth of a grain of morphine in the solution. Following the administration of glucose the patient usually feels soothed, his tense muscles relax, his pulse rate drops, and he passes into a refreshing sleep. This sleep is not necessarily due to the morphine, for the same result will follow the use of the morphine-free solution.

As to the relative merits of the various polyvalent vaccines, I have nothing to suggest. The one selected should be fresh and prepared by a reliable laboratory.

This is intended neither as a scientific nor as an exhaustive treatise

on vaccine-therapy, but is a simple statement of some of the clinical observations and results noted in rather a large series of cases treated by vaccines, in the hope of interesting the profession in what I believe to be the most potent agent we have in combating this deadly foe.

The complete case reports and accurate laboratory findings which I should like to give you are not available because they do not exist. This institution, like many others, was swamped by the sudden and overwhelming onset of this epidemic, and the recording of accurate data was a physical impossibility.

Our series embraced 8,000 cases of influenza and 1,000 cases of pneumonia. The relative high percentage of pneumonia is explained by the fact that many of our cases came in from camp hospitals and infirmaries which cared for their own influenza cases. The pneumonia mortality record for the entire series was 18 per cent, while in the wards where vaccines were used the mortality rate was under 7 per cent. In one series of 200 cases not treated with vaccine, fluid developed in 25 per cent of the cases; 18 per cent came to operation for empyema.

In the last series of 50 cases of pneumonia treated with vaccines, two died during acute stage and one following mastoid operation. There was not a single case of empyema. These patients were treated in warmed, well-ventilated wards, carefully protected from chilling by draughts or unnecessary examinations. Probably no fad in medicine has accounted for more deaths than the open air treatment of pneumonia.

CONCLUSIONS

1. That a prophylactic dose of vaccine will confer immunity for from six to eight weeks.

2. That as a remedial agent, vaccine, if given at the onset, will materially shorten and lessen the severity of the attack and pneumonia will be a rare occurrence.

3. That vaccine given to a pneumonia patient will ameliorate the severity of the symptoms, hasten crisis, and cut the number of serious sequala to a minimum.

4. That glucose, intravenously, combats accidosis, gives nourishment to the heart muscle, adds fluid to the body, and has a decided diuretic action.

WHY AN AVIATOR IS EXAMINED BY THE REBREATHING METHOD AND HOW OFTEN THE EXAMINATION SHOULD BE MADE

By Lieutenant VERNER T. SCOTT
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TWO of the questions most frequently asked by those not familiar with aviation medicine is, "How do rebreathing conditions simulate high altitudes and how can you determine an aviator's limit in altitude by examining him on a rebreather machine at sea level?"

A brief statement concerning altitude physiology is necessary to appreciate the principle of the rebreather. It was Paul Bert in 1878 who first found that it was the decrease in the partial pressure of the oxygen of respired air that caused the symptoms of mountain sickness. Since that time it has been clearly proved that a decrease in the partial pressure of the oxygen of respired air regardless of the method of reduction produces the symptoms appearing at high altitudes.

There are three methods used at the Medical Research Laboratory (Air Service, Mitchel Field, L. I.) to reduce the partial pressure of oxygen: (1) the rebreather machine, (2) the low pressure chamber, and (3) the nitrogen dilution apparatus (Air Service, Medical, 1919).

The low-pressure chamber is a cylindrical steel tank with a capacity sufficient to hold six people. The reduction of pressure is brought about by means of a motor driven vacuum pump capable of rarefying the atmospheric pressure equal to that found on any altitude flight.

Unfortunately there are some who still believe that altitude symptoms are produced by the effect of the lowered barometric pressure on the surface of the body. Schneider, working in this laboratory, confirmed the work of Paul Bert by a number of experiments. He placed two men in the low-pressure chamber, one supplied with oxygen and one without oxygen. The subject taking oxygen during the experiment remained as comfortable and as efficient as at sea level, while the subject without oxygen experienced an increase of pulse and respiration, and became cyanotic and mentally inefficient. In fact, this point is demonstrated daily. The clinician who accompanies every subject in the low-pressure chamber is supplied with oxygen through a rubber tube with a wooden nipple. He holds this nipple in his mouth in the same manner a cigar is held, and during the experiment he remains perfectly comfortable and efficient while the subject undergoes the compensatory reactions incident to reduced partial pressure of oxygen.

The rebreather machine is used for the official classification of aviators because of its simplicity and ease of operation. An aviator rebreathes into a metal tank by means of a mouthpiece and two corrugated rubber tubes. The carbon dioxide is removed by a caustic soda container in the expiration pipe. The oxygen percentage in the mixture grows progressively less. Starting with 52 liters of air the average subject will reduce the oxygen to 7 per cent in 30 minutes.

A comparison of the analysis of alveolar air found at different levels of rarefied air with that on the rebreather with their corresponding partial pressures will be of interest:

LOW PRESSURE CHAMBER [1]

Alveolar air	Barometric pressure	Alveolar partial pressure
760 mm.	Oxygen....14.5 per cent.	(760–40) = 104.80
Sea level.	CO_2..... 5.5.....	(760–40) = 39.60
560 mm.	Oxygen.....14.0 per cent.	(560–40) = 72.80
10,000 ft.	CO_2..... 7.0.....	(560–40) = 36.40
350 mm.	Oxygen....13.0 per cent.	(350–40) = 40.30
20,000 ft.	CO_2.....10.5.....	(350–40) = 32.55
	Rebreathing machine	
21.95 per cent.	Oxygen....14.5 per cent.	(760–40) = 104.40
Sea level.	CO_2..... 5.5.....	(760–40) = 39.60
14.2 per cent.	Oxygen....10.0 per cent.	(760–40) = 72.00
10,000 ft.	CO_2..... 4.5.....	(760–40) = 32.40
9.7 per cent.	Oxygen..... 5.6 per cent.	(760–40) = 40.32
20,000 ft.	CO_2..... 4.5.....	(760–40) = 32.40

Partial pressure of alveolar air = barometric pressure minus vapor tension (40) x per cent of gas

Whereas in altitude flights the partial pressure of O_2 is reduced by a lowering of barometric pressure, so it is seen that the same thing is accomplished on the rebreather machine by decreasing the percentage of oxygen.

Classification of the aviator by the rebreathing method clearly defines the altitude or low oxygen tension which he can tolerate and still remain mentally and physically efficient.

Providing he is in good physical condition at the time of the test, the subject will not be able to raise his limit by repeating the rebreathing test. Practice on the rebreather does not increase one's tolerance

[1] Lutz and Schneider, *American Jour. Physiology*, Vol 1, No. 3, December, 1919

for low oxygen. This has been demonstrated by the men connected with the Medical Research Laboratory. There have been some who, for experimental purposes, have taken the test two or three times a week for months and have found their last test no lower in oxygen than some earlier ones.

Just as some men are more resistant to disease than others so do we find some men more resistant to low oxygen than others.

Different aviators in good condition vary in their ability to reach low oxygen. Some reach 6 per cent, others 8 per cent oxygen.

Subjects in poor condition will range from 13 per cent to 9 per cent. The causes which lower the "ceiling" of air men are acute and chronic diseases, staleness and lack of exercise plus loss of sleep, plus excesses. The importance of physical exercises and regular habits to the air is apparent. At one time there was a tendency to under-estimate the value of the rebreathing classification because there were occasions when a man who, being limited to a certain altitude, exceeded this limit and returned without unpleasant experiences.

There are two reasons for this, either (1) his "ceiling" was established when not in very good condition and his flight taken when in better condition, or else (2) he was within the safety margin. He is given an altitude within which he will remain his best. He may at times exceed this limit, but not within danger.

In view of our increasing knowledge and experience in aviation medicine, we believe an aviator's tolerance for low oxygen should be established in all cases before he is permitted to fly, at least once a year thereafter, and always after any serious physical or mental illness.

A CASE OF GANGRENE OF THE TOXIC AND EDEMATOUS TYPE DUE TO THE WELCH BACILLUS[1]

By JOHN H. JOPSON, M.D.

OUR knowledge of the etiology, pathology and treatment of infectious gangrene due to gas-producing organisms of the anaerobic type has been vastly added to by the experience derived by pathologists and surgeons during the recent war. Up to that time the experience of surgeons was usually confined to a few cases personally seen and treated, and to the study of casual reports of what was to a certain extent a surgical curiosity, sufficiently rare for each case to be noted and reported upon by those of an inquiring turn of mind. It unfortunately fell to the lot of those operators serving in France to increase their observations twenty-five, fifty or a hundred fold. At the same time the efforts of laboratory workers were quickened and stimulated to develop a serum treatment which would be a reliable adjuvant to the surgical treatment which was gradually evolved by the intensive study of this frequent and frightful complication of a large percentage of soft part wounds. This intensive study on the part of a large number of workers, whose efforts were spurred on by every consideration of patriotism and humanity, could not fail in this, as in many other fields of traumatic surgery, to bring forth results which will be of permanent benefit to the world at large. We find that both in the operative treatment and the serum therapy of emphysematous gangrene great strides have been made, and that we are in a position today to recognize and to value at their respective worths both of these methods of treatment, once the infection has developed. As to the prophylactic value of the serum treatment, it is difficult to make an estimate, as the observations on a large scale of the early systematic administration of the serum were not begun until late in the war, and we have seen no published analysis of the results obtained. The studies of Bull were mainly in the direction of providing a serum potent against infection by the *Bacillus aerogenes capsulatus* of Welch, or the *Perfringens bacillus*, as it was commonly designated by the French. At the same time Weinberg who has contributed so extensively to our knowledge of the anaeroids, and Seguin were interested in the production of a polyvalent serum, which would be available in the treatment of other types of anaerobic infection, whether occurring together with the perfringens or singly, especially the *B. oedematiens* and the *Vibrion septique*. While the

[1] Read before the Joint Meeting of the New York Surgical Society and the Philadelphia Academy of Surgery, Philadelphia, February 5, 1920.

Welch bacillus was the most common anaerobe identified in gas gangrene, these other types were observed with sufficient frequency to demand recognition, besides a large number of greater rarity or of little virulence. In addition to the polyvalent serum, a special serum, had been obtained for the *B. oedematiens* above, but was not in general use. The Germans also had an anti-gas serum which was contained in some of their captured field kits in 1918, the labels on which described the method of administration, but made no great claims for efficacy. While the Bull serum (anti-Welch) was obtainable in the latter part of 1918 in safe and convenient form for administration, the polyvalent serum of Weinberg and Seguin had not obtained the recognition generally of the French or the confidence of the laboratory chiefs of the American forces. That a polyvalent serum is desirable where cases of more than one variety of anaerobic injection are liable to be met with, either in civil or military practice, is indicated by the case which we here desire to place on record. It was reported at the Societe de Biologie, July 26, 1919, by Dr. Weinberg for Dr. Theodore C. Beebe, who saw and studied it with me, and I am indebted to these gentlemen for permission to publish it in this country.

Pvt. C. D., Infantry, was admitted to Evacuation Hospital No. 1, A. E. F., on October 20, 1918, with multiple gunshot wounds (machine gun or rifle) of the left thigh and the left heel and ankle. The thigh wound was in the middle third, outer aspect, perforating, of large diameter, dividing the vastus externus muscle. That of the heel and ankle, also perforating, was associated with a compound fracture of the tuberosity of the os calcis, and a laceration of the tendo Achillis. X-ray examination showed the thigh wound free of foreign bodies of a metallic nature, but a large piece of the jacket of a bullet, and several smaller fragments were lodged in the heel and ankle.

Operation was performed nine hours after receipt of wound. The usual debridement was carried out. In the thigh double incisions were made and the tract excised. No sutures were used. In the heel wound an L-shaped incision exposed the wound in the heel and ankle, foreign bodies and bone fragments were removed, the tendo Achillis and its attachment to the separated extremity of the os calcis were preserved, the soft parts debrided, and both wounds were packed with gauze for twenty-four hours and then subjected to the Carrel-Dakin treatment. For ten days the post operative course was uneventful. Smears and cultures made October 21, the day after operation, showed: left thigh, posterior wound, *B. Welchii*, unidentified anaerobe, 3 per field; anterior wound, B. tertius, diphtheroids, staphylococcus, 10 per field. Left foot, *B. mesentericus*, staphylococcus unidentified anaerobe; October 25, smears, left thigh, 9 per field; left foot, 1 in 12 fields. Eight days after operation no Gram. positive bacilli were present. No complications or untoward symptoms were noted for ten days, when an evening rise of temperature first appeared, accompanied by pain in the thigh, and on November 1 examination of the posterior wound at the daily dressing showed an induration at its lower end, with a slight watery secretion. Cultures on this date showed a few cocci in pairs and staphylococcus albus on the posterior wound, and cocci in chains with the staphylococcus albus on the anterior thigh wound,

also an unidentified anaerobe. On November 2 the patient's condition was much changed for the worse. The temperature was 100° to 102°, the pulse rapid, and much pain was complained of in the thigh. There was an extensive induration over the posterior surface of the limb at the site of the wound and extending upward to the buttock on the same side, but most marked around the wound. Secondary operation the same day. The posterior surface of the thigh was opened through the wound and the indurated area by long incision. There was great swelling and edema of the subcutaneous tissues and of the intermuscular tissues as well. The muscles were the site of a necrosis of peculiar appearance, entirely different from that commonly seen in gas gangrene of the type with which we were familiar. They were greatly indurated, the cut surfaces anemic, mottled and homogeneous, on section cutting almost like cartilage. Muscular contractility was lost, no gas was present in the tissues, and odor was practically lacking. As a streptococcus infection had been anticipated, we were much puzzled by this unusual and, in our experience, unique appearance. A limited excision of the muscle surfaces and extensive intermuscular dissection of the different planes to facilitate drainage was done. Cultures were made by Captain Beebe, who had requested at this time that he be summoned for all cases of gas gangrene, and portions of the excised muscle tissue were sent to the laboratory. Edematious infection was suggested by Captain Beebe. Operation was poorly borne by the patient, who was sent to the shock ward.

The following day the patient's condition was poor. The temperature was normal, and the mind clear, but he was very restless, the skin and mucous membranes pale, the former of a yellow tint, the pulse rapid and feeble, while vomiting occurred at frequent intervals. The wound was the site of a profuse watery drainage, and there was now a gangrenous odor to the discharge. The induration persisted to the same extent as before. Examination of the hanging drop of muscle serum, and of smears taken at the time of operation, and the clinical appearance had led Captain Beebe to regard the infection as probably due to the *Bacillus oedematicns,* and an ampoule of anti-edematiens serum, which he had obtained shortly before for laboratory use, was injected. The soldier died suddenly the same day during his dressing, consciousness being preserved until just before death. At autopsy the findings were similar to those at operation: Extensive edema of the subcutaneous and inter- and intra-muscular tissues, and a dense induration of the muscles on the outer and posterior surfaces of the thigh, with a necrosis apparently not universal, but in small scattered darker patches throughout the muscles.

Bacteriological Report.—As already mentioned, the examination at the time of the second operation showed in hanging drop thick bacilli of different dimensions, the immobile ones resembling *B. perfringens* or *B. oedematiens;* others, mobile and longer, apparently of another variety. The bacilli were Gram-positive on staining, and the absence of cocci and of leucocytes indicated the lack of resistance on the part of the patient and was an index of the gravity of his condition. Cultures from the muscle serum showed two organisms, an anaerobe, which was later identified as *B. perfringens,* and an aérobe, the *B. anthricoides.* Further studies made in Professor Weinberg's laboratory confirmed these findings.

A peculiar interest attached itself to this case for several reasons. In the first place it was the only case of its kind observed, as far as our knowledge goes, at Evacuation Hospital No. 1, and our experience covered most of the period of activity of that hospital. In its long-delayed development, pathology, and constitutional symptoms and

clinical course, it was strikingly different from ordinary cases of gas gangrene. At this time Captain Beebe was particularly interested in the search for oedematiens infection, by reason of the frequent reports of its presence in the hospitals of the Paris district. While the preliminary examination apparently confirmed the suspicions aroused at the time of the second operation, and the oedematiens serum was accordingly administered, the cultures failed to show other than the Welch and anthricoides organisms, and it remained for Weinberg to properly group this case as one of a rare type, to which he had called attention. Two similar cases have been observed and reported, the first by Weinberg himself at Depage's hospital at LaPanne, and the second in the service of Chutro at the Hôpital Buffon in Paris. The first mentioned was fatal. The latter case recovered after treatment with serum.

I cannot improve on the language in which Dr. Beebe draws his conclusions:

The bacteriological study of this case shows that our patient had been affected by the toxic or edematous gas gangrene caused solely by the *Bacillus perfringens*. He furnishes a new proof of the fact that the toxic form of gas gangrene is not due to a single species of microbe, but that the clinical syndrome may be provoked by different anaerobes. The mistake which we made in treating the case by the anti-oedematiens serum pleads in favor of treatment of all cases of gas gangrene by the mixed serum, such as is recommended by Weinberg and Segúin. In effect, even when the gas gangrene is caused by a single species, it is difficult to make an extemporaneous diagnosis of the pathogenic agent of the disease, but nevertheless it is necessary to have immediate recourse to serum treatment if one wishes to save the patient.

A REPORT OF WOUNDS INVOLVING THE HEAD AND SPINE CARED FOR AT EVACUATION HOSPITAL NO. 8, A. E. F.

By Lieutenant ADOLPH M. HANSON
Medical Corps, United States Army

THIS report includes all wounds of the head and spine cared for at Evacuation Hospital No. 8 from June 6, 1918, to and including November 28, 1918.

Total number recorded	[1]493
Total number reported to the Surgeon General, U. S. A.	460
Total number classified	449
Lower orbit, face, and jaw injuries, not classified	11

SCALP WOUNDS

Scalp only	136
Deaths	0
Scalp (wounds elsewhere)	77
Deaths	8
Mortality (wounds elsewhere), per cent	10.4
Total mortality, per cent	3.7

SKULL FRACTURES (DURA INTACT)

External table	31
External table (wounds elsewhere)	3
External and internal tables	54
External and internal tables (wounds elsewhere)	14
External and internal tables (inoperable)	1
Total operated	102
Total operative deaths	4
Operative mortality, per cent	3.9

PENETRATING CRANIO-CEREBRAL, CRANIO-CEREBRO-SINUS, AND CRANIO-SINUS INJURIES

Penetrating cranio-cerebral and cranio-cerebro-sinus	82
Pentetrating cranio-cerebral (wounds elsewhere)	1
Penetrating cranio-sinus (cerebrum intact)	3
Inoperable	3
Total	89
Total deaths	38
Total operative deaths	35
Operative mortality, per cent	39.3
Total mortality, per cent	44.2

SPINAL INJURIES

Bony Spine Only

Cervical	7
Dorsal	1
Lumbar	1
Not specified	2
Not specified (wounds elsewhere)	1
Total	12
Deaths	0

[1] The records of 33 are so incomplete as to be worthless and have not been used in the classified tabulation.

Spine and Cord

Cervical	4	Total operative deaths	15
Cervical (inoperable)	3	Mortality bony spine only, per cent	0
Dorsal (wounds elsewhere)	2	Mortality spine and cord, per cent	71.8
Lumbar	5	Operative mortality spine and cord, per cent	62.5
Lumbar (wounds elsewhere)	3	Total operative mortality (bony spine only and spine and cord), per cent	34.1
Not specified	6	Total mortality, per cent	52.3
Not specified (wounds elsewhere)	4		
Not specified (inoperable)	5		
Total	32		
Total inoperable	8		
Total deaths	23		
Total operated	24		

OPERATIONS

Excision of scalp with exploration of Skull	213	Decompressions	15
Deaths	8	Deaths	4
Mortality, per cent	3.7	Mortality, per cent	21.4
Trepanations of skull	105	Laminectomies	18
Deaths	33	Deaths	13
Mortality, per cent	31.4	Mortality, per cent	72.2

The results tabulated[2] include all information that I have been able to secure by sending out letters to home addresses and by checking up with army records as completely as possible those that died after evacuation and up to January 1, 1920. The technique followed is that described by Dr. Harvey Cushing in the *British Medical Journal* of February 23, 1918, with the exception that ethyl alcohol was left in the track in the brain instead of dichloramine-T with eucalyptus oil and the use of a dural separator[3] and bone elevator for the internal table following the use of the drill, which greatly facilitates the cutting out of a block of bone and prevents tearing of the dura.

In a general way the technique followed at Evacuation No. 8 was as follows:

After excision of the scalp wound and the completion of a tripod, Isle of Mann, or crucial incision, trepanation of the skull was performed always in cases with depressed fractures or about an opening formed by a missile. The wound was then swabbed out with ethyl alcohol, including the dura, soiled instruments laid aside, gloves changed, and sterile towels tucked over the edges of the wound and secured by skin clips. No attempt was made to excise the edges of the torn dura. Then the patient was asked to cough, and very often much pulped brain substance and pieces of indriven bone were extruded. A soft rubber catheter was then passed through the opening in the dura in a search for pieces of indriven bone and steel fragments or bullet. When located with the

[2] Mortality figures have been computed regardless of complications: wounds elsewhere, "gas" infection, etc.

[3] Dural Separator and Bone Elevator for Craniotomy, Hanson: *Journal A. M. A.*, September 13, 1919, Vol. 73, p. 853.

catheter, they were removed with the aid of an esquillectomy forceps. From time to time the track in the brain was irrigated with warm sterile deci-normal saline solution through the catheter removing debris and pulped brain substance. When no more foreign bodies could be felt, a little ethyl alcohol was injected through the catheter on being withdrawn. The wound was again carefully swabbed out with ethyl alcohol and the scalp closed in layers. Interrupted No. 2 chromic gut sutures were placed in the galea and interrupted silk sutures in the scalp. The silk sutures were removed in three to four days.

Whenever possible, vessels of the dura and pia found bleeding were ligated with fine silk; but in cases coming to operation thirty-six to seventy-two hours after injury was received, thickening and friability, due to inflammation, rendered it easier to control such hemorrhage by applying small silver clips.

Small perforations or tears of the sinuses were controlled by muscle graft, and large tears by applying a piece of pericranium over the rent in the sinus, keeping it in place gently with the gloved fingers for two minutes. This effectually controls the hemorrhage, adhering like a postage stamp to a letter. It produces a rapid clotting, and the resulting thrombus completely blocks the sinus well beyond the margins of the injury.

In a subsequent article I will report a series of cranio-cerebral injuries, describing each operation in detail. This is a brief summary of a certain class of injuries treated in an evacuation hospital in the zone of the advance.

CONCLUSION

1. Head injuries should be operated as early as possible.

2. All injuries of the head should be operated under local anesthesia unless complicated by wounds elsewhere.

3. Excision of a scalp wound should always be done and the skull explored for a fracture, as often the small and apparently trifling scalp wounds reveal a perforation of the skull.

4. Foreign bodies in the brain should always be removed, if possible to do so without producing added injury to the brain, and in a silent area, even though more of the brain must be destroyed.

5. The scalp should always be closed in two layers, using interrupted sutures.

6. Patients with penetrating cranio-cerebral injuries, after operation, should not be moved for six weeks.

7. Wounds of the spine with a complete severance of the cord should not be operated.

8. Patients with or without complete severance of the cord should not be catherized, as infection invariably and promptly follows.

9. The mortality in wounds of the spine, even when the cord is not severed or only slightly injured, is high because of the frequent complication of abdominal and chest wounds.

ACKNOWLEDGMENTS

I wish to acknowledge my obligations to Col. Harvey Cushing, Col. J. F. Hall, Lieut. Col. Arthur M. Shipley, Lieut. Col. A. Weeks, Lieut. George Cronan, Capt. George E. Alleman for his X-ray studies, and to the doctors, nurses and enlisted personnel, without whose help this work would have been imposible.

Lieut. Col. Alanson Weeks, Chief of Surgical Team No. 50, and Lieut. John H. Woolsey were attached to this service temporarily with Evacuation Hospital No. 8 during the Chateau Thierry and Argonne fighting.

REPORT ON THE ECONOMIC CONDITIONS OF THE POORER POPULATION OF THE CITY OF TRIER, AS DETERMINED BY HOUSE TO HOUSE VISITS

By Colonel EARL H. BRUNS
Medical Corps, United States Army

(With one illustration)

TO OBTAIN definite information concerning the living and health conditions of the poor people of Trier, especially with reference to the effects of the war, the homes of over 1,000 families were visited by German-speaking nurses from the U. S. Army Nurse Corps. The American nurses were accompanied by German Social Welfare nurses from the city of Trier dispensary, and the poorer families in the various streets were selected. The population of Trier is 53,899 (1917 census). It is one of the larger cities in the Mosel Valley, the principal industry of which is the raising of grapes and the making of wine. Until recent times this part of Germany has been more or less isolated, and owing to this there has been considerable intermarriage which, coupled with relative more poverty and the consumption of alcohol, has led to a population of reduced statue, physique and health stamina. We are told that the poor people are not as cleanly about their homes as in other parts of Germany. The incidence of tuberculosis is comparatively higher in this region than in the remainder of Prussia. As the amount of tuberculosis is a good index of the living conditions of a civilized people, we would expect to find, in Trier, room for improvement in this respect. The effect of the war is taking brother, husband and father away from the home, and throwing extra and unusual work on the women, we would anticipate a neglect in the cleanliness of dwellings and the care of children for this reason alone.

The principal industry of the city of Trier is the handling of wine. In addition to this some manufacturing is done on a small scale. There are several small breweries, a rag factory, where rags are sorted and prepared for the manufacture of paper, a small glass factory, pottery, cigarette factory, etc. In the rag factory a nurse is in constant attendance, and there are certain regulations with reference to the hygiene of the employes. In addition to earnings from employment, the poor people are protected by sickness, accident and invalid insurance and unemployment pensions. All employes with less than a yearly income of 4,000 marks are required to carry insurance of which they pay two-thirds and their employer one-third. In case of sickness they receive appropriate treatment and monetary assistance until they are able to return to

work. As soon as it becomes apparent that they are to be premanent invalids they pass under the invalid insurance, which also provides for the care of old people. Accident insurance only applies to injuries. Germany in this way probably does more than any other country for the man on small pay who is unable to lay aside any money. At the beginning of the armistice, a non-employment pension varying from (1) one to (4.50) four and one-half marks per day was started for those completely unable to work. In February, 1919, at the time of this investigation, there were 450 unemployed in Trier, and it was estimated that 150 more had not applied for assistance. Supplementing these, we have the war pensions for the dependents of deceased or imprisoned soldiers and those disabled in the war.

One of the chief motives for undertaking these investigations was to determine the effects of the war ration on the health of the poor people. In the early part of 1915 the whole of Germany was placed on a war ration. This consisted of 30 gms. of fat, 100 gms. of meat, 20 gms. of sugar, 7 pounds of potatoes and 4 pounds of war bread per person per week. The caloric value of the average daily amount of food which each person consumed in peace times had been reduced from 3,000 to 1,400 calories. Through the illicit traffic in food, the rich man, and even the man of moderate means, was able to obtain extra food, but not so the poor.

The following is a résumé of the investigations:

Number of families visited	1,017	Number with seven people	138
Number with two people	10	Number with eight people	104
Number with three people	90	Number with nine people	74
Number with four people	148	Number with ten people	77
Number with five people	208	Number with eleven people	5
Number wi sixth people	159	Number with twelve people	4

Average number of rooms occupied by families	3.52
Number of homes in which sanitation was good	609
Number of homes in which sanitation was poor	4.08
Average number of living children in each family	4.08
Average number of dead children in each family	2.07
Number of families with one child	76
Number of families with two children	149
Number of families with three children	182
Number of families with four children	158
Number of families with five children	142
Number of families with six children	100
Number of families with seven children	82
Number of families with eight children	49
Number of families with nine children	21
Number of families with ten children	51
Number of families with sickness at time of visit	757

Number of families with history of tuberculosis	282
Number of families with some member with tuberculosis	379
Number of cases of pulmonary tuberculosis in all families visited	343
Number of cases of scrofula in all families visited	249
Number of cases of other forms of tuberculosis in all families visited	43
Father with tuberculosis	104
Mother with tuberculosis	120
Children with tuberculosis	395
Average earnings of all families, per week, marks	61.02
Average cost of living of all families, per week, marks	51.89
Number of families earning less than 200 marks per month	719
Number of families earning more than 200 marks per month	298
Number of families with personal cleanliness good	701
Number of families with personal cleanliness poor	316

The average meals of each family consisted of the following:

Breakfast.—Coffee substitute (no milk, sugar at times), marmalade (made from beets), war bread.

Dinner.—Potatoes and green vegetables (meat on Sundays; some families had horse meat twice a week).

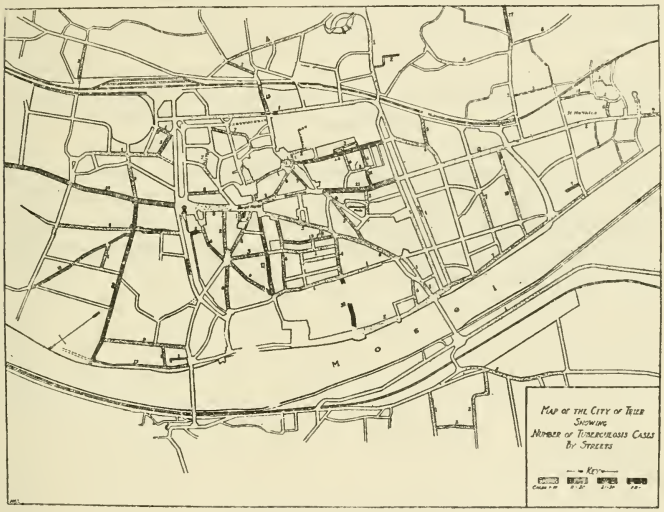
4 *p. m.*—Coffee substitute, war bread, marmalade.

Supper.—War soup, war bread.

Considering the distribution of tuberculosis by streets (see chart at tached) it is noted that 52 cases occurred in one street (Krahnen Strasse) and from 21 to 30 in three others (Maar, Weberbach and Neu). These streets include the homes of more of the extremely poor class. Krahnen Strasse, in which 52 cases were discovered, contains a large number of overcrowded tenement houses in which the sanitary conditions are very bad.

The results of these visits brings to our attention, in a way not to be questioned, the suffering of the poor as a result of the war. The visiting nurses frequently found the children locked in the homes while the mother was away working. The picture usually presented was a small three-room apartment in an overcrowded tenement house poorly ventilated and poorly lighted. In the kitchen was the only stove, and here the family lived. In one or two very small, dark bedrooms the family slept, and one wondered at times where they all found a place to lie down. A small oil lamp in the kitchen was the only light at night. There was usually no running water in the building, and one toilet in the hall-way sufficed for all the families on that floor. The size of the families was another feature. Almost half of them had five or more

children. The amount of sickness was also striking. In three-fourths some member was sick. Scrofula and rickets was very common in children; pulmonary tuberculosis and influenza in adults. The proportion of tuberculosis, however, gives a false impression. The diagnosis of scrofula had often been made by the family physician, who is inclined to pronounce every anemic child, undernourished, undeveloped, and with palpable glands, as scrofulous. While such an array of objective symptoms is very suggestive, it does not always mean scrofula. The visiting nurses being in association with the German nurses from the dispensary, many poor families known to them through sickness would



naturally be visited which included most of the tuberculous families under the supervision of the dispensary. The visits nevertheless showed the frequency of tuberculosis, also the infected surroundings and the kind of human material which would prove easy victims to the tubercle bacillus. As previously discovered in examining school children, malnutrition, as a result of the war ration, was becoming very common among the poor. Mothers wept as they told our nurses how they must put their children to bed hungry at night and send them to school hungry in the morning.

The earning capacity of the family included not only wages, but in-

surance money and pensions. The cost of living only comprised rental and cost of food. In other words, by subtracting the average cost of living from the earnings, each family had on an average 9.23 marks a week to spend for clothing, extra food, wine, beer, tobacco, etc. It was found that very few families, owing to the high price of wine and the poor quality of beer, used alcohol in any form. Poor personal cleanliness was noted for about one-third of the families. The explanation usually given was lack of soap, the expense of new clothing and the working out of the mother. The mother who worked all day came home too fatigued at night to devote much time to the tidiness of her home and the care of her children. Some families had been unable to purchase any new clothing or shoes since the beginning of the war. Great difficulty has been found in taking care of the sick. In this connection the dispensary has been doing excellent work, helping the mothers, supplying medicines, money and extra nourishment. The German system of food distribution permits of a certain amount of milk and better bread to the sick, also milk to nursing mothers and babies.

As a result of visiting the homes of a large number of poor people, we are convinced that the war has brought tremendous hardships on the poor people in the city of Trier. Due to overwork, neglect of homes and children, and especially the war ration, disease, especially tuberculosis, has increased among this class.

THE TREATMENT OF WEAK OR FLAT FEET WITH REPORT OF A NEW COMBINATION FOOT SUPPORT

By Captain JOHN CARLING
Medical Corps, United States Army

(With three illustrations)

THE successful treatment of weak or flat feet is dependent on a thorough knowledge of the anatomy and functions of those members.

The foot consists of twenty-six small bones, bound together by ligaments and controlled by groups of muscles. Nature has provided a large number of small bones in order to insure flexibility and spring to the step. The ligaments of the foot are strong and numerous and bind the bones together to form the arches, while the muscles supply strength and motion.

The arches of the foot are (*a*) the longitudinal or principal arch, and (*b*) the anterior or transverse arch (Fig. 1). The longitudinal arch lies along the inner and underside of the foot, between the heel and the head of the first metatarsal bone. The highest part of this arch is at the junction of the astragalus and scaphoid bones, about one inch in front of the ankle joint. The anterior or transverse arch lies under the anterior portion of the foot and is formed by the heads of the metatarsal bones.

When the foot is placed on the ground the bones forming the arches descend slightly under the weight, and when the foot is raised they resume their elevated position. The arches are, therefore, nature's "shock absorbers," and when weakened or broken down the individual loses that elasticity and spring to the step which makes walking an enjoyable and most healthful exercise.

The foot has two functions: (1) as a support for the weight of the body in standing, and (2) to raise and propel it in walking. To properly perform these functions, the muscles should be strong and active, and normal strength and activity are impossible unless the bones forming the arches occupy their normal position.

In the act of walking the weight of the body is largely supported by the muscles, but, when standing, the muscles are relaxed and the weight is thrown upon the ligaments. If the muscles are weak and unable to perform their function, the strain in walking falls upon the ligaments, which eventually give away, allowing the arches to fall. In this condition the muscles are compelled to work at a great disadvantage, and the effort to "carry on" causes pain and tenderness under the arches. This sometimes extends to the muscles of the calf, hip and lower back and is often mistaken and treated for rheu-

matism, lumbago or sciatica. Corns and callosities are frequently present which greatly aggravates the condition and the general health and efficiency of the individual becomes greatly impaired.

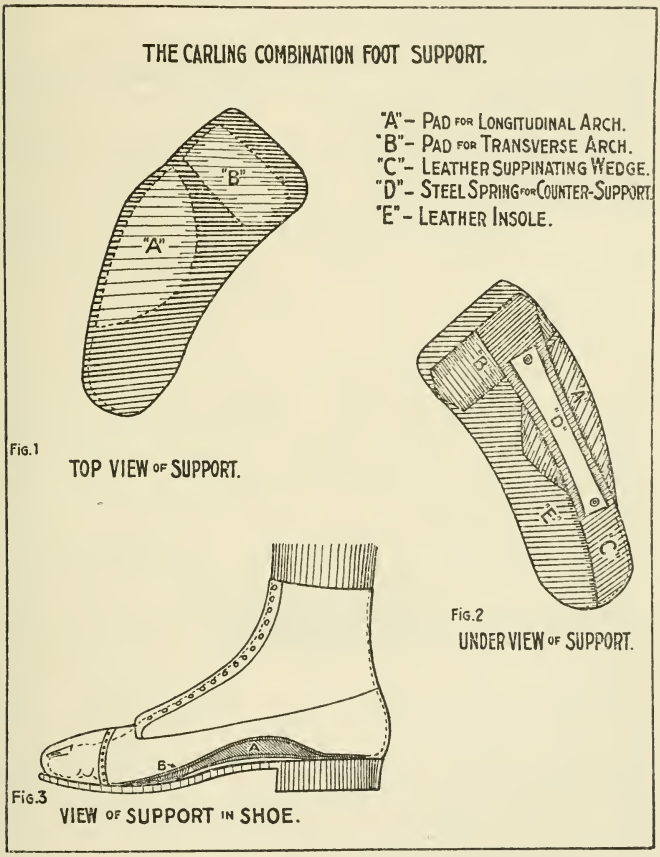
Treatment.—The first essential in the treatment of all foot ailments, is a properly fitting shoe. Such a shoe should conform to the shape of the normal foot, with a moderately low heel and room enough for the toes. The next step is to strengthen the weak and stretched muscles by suitable exercises, in order that they may properly perform their functions. It must be borne in mind, however, that a weak muscle cannot be strengthened while working under the strain of a broken arch; therefore a support should be worn in the shoe to hold the displaced bones in their proper position until the muscles have recovered their lost power. This is absolutely essential once the ligaments have given away, because while muscle tissue has the power to contract, fibrous tissue of which the ligaments are composed has no such power.

Various forms of support have been devised to relieve the strain of flat feet, very few of which have any merit, while others do positive harm. This is because they are frequently made by individuals without medical education and therefore without a full and comprehensive knowledge of the anatomy and functions of the feet. Arch props made with inserts of leather or hard rubber under the sole are of very little value, because they fail to support the inner side of the foot, or key of the arch, and when the shoe breaks down from pressure of the pad they become utterly worthless. Metal plates, with or without a covering of leather, are heavy and cumbersome and, by splinting the feet, interfere with the action of the muscles and cause further weakness.

The author, after long experience as an orthopedic surgeon in civil and military practice, has devised a combination support which fulfils all the requirements for the successful treatment of weak or flat feet and effects a cure by encouraging functional use of the muscles.

Description.—The support consists of a flexible leather insole extending from the heel to the head of the metatarsal bones. On the under surface are two compartments or pockets (Fig. 2). (*a*) for the longitudinal arch and (*b*) for the anterior or transverse arch. These pockets, when filled with felt or other resilient material, conform to the shape of the arches, and by varying the amount of material introduced they may be raised and adjusted to meet the requirements of individual patients. A sufficient amount of padding and an instrument for adjusting it are provided for each case.

Metatarsalgia, or pain under the ball of the foot, is caused by a lowering of the bones forming the anterior arch (*b*). In such cases the padding in the anterior pocket is placed immediately behind the



metatarsal heads, and by raising one, or all of them if necessary, the pressure is removed and the pain and callus disappear.

In the condition known as flat foot, in addition to a lowering of the arches, the feet are usually pronated, throwing the weight upon

the inner or weaker border. To overcome this tendency and balance the foot a supinating wedge of leather (*c*) ⅛ inch thick, is attached anteriorly and posteriorly to the under surface of the support, thus raising the inner border and obviating the necessity of inserting a wedge in the sole of the shoe.

On the under surface of the supinating wedge is attached a light steel spring, (*d*), which serves as a counter support to the longitudinal arch and, by strengthening the shank of the shoe, maintains the efficiency of the support at all times.

It will thus be seen that a support has been provided with, (*a*) a support for the longitudinal arch, (*b*) a support for the anterior or transverse arch, (*c*) a supinating wedge to overcome pronation, and (*d*) a counter support for the longitudinal arch. It is, moreover, light, flexible, adjustable, comfortable to wear, simple and efficient.

EDITORIAL

THE GERMAN MEDICAL HISTORY OF THE WAR

"Fas est ab hoste doceri"

A prospectus of the official German Medical History of the war has recently been issued by the publishers (J. A. Barth, Leipzig), being a pamphlet of twenty-six pages, the major part of which consists of the Introduction to the series by Lieut. Gen. Otto von Schjerning, Chief Surgeon of the Medical Corps of the German Army in the Field. The work is to consist of nine volumes, the first of which is to appear in the fall of 1920. The first two volumes will deal with military surgery (1500 pp.) and the other seven, in succession, with internal medicine (900 pp.), neurology and psychiatry (500 pp.), ophthalmology (600 pp.), oto-rhino-laryngology (300 pp.), hygiene (500 pp.), pathology (600 pp.) and Roentgenology (450 pp.). The work will, therefore, be a strictly Medical History of the War, since there is no evidence that the administrative mechanism of such a vast enterprise as the medical service of an army of some 11,000,000 men will be dealt with. The material will be purely scientific. Remarkable is the apparent wealth of the prospective material in the subjects of neurology, ophthalmology, military hygiene, pathology and Roentgenology. But given the long, careful course of preparation made and four full years of an unparalleled experience with military medicine in the field, this should not be surprising. It is surprising, however, that no provision has been made for the detailed exposition of such subjects as the physiological aspects of aviation, the pathology and treatment of gas poisoning and the physical reconstruction, reëducation and rehabilitation of the crippled, the blind, and of those rendered helpless by the effects of the wounds, since these subjects had attained a high degree of development among the enemy, even before the war. The arrangement of subjects in the different volumes, subjoined at the end, is admirable, carefully thought out, and remarkable for the number of eminent names which figure among the prospective authors. The merits of this arrangement of subjects turn naturally upon the accumulated experience of four years running and the large amount of material collected in that time. The introductory chapter by Gen. von Schjerning, which is subjoined, gives a clear account of the work done by the Medical Corps of the German Army in the field and is followed by some five pages of valuable statistics, which are also subjoined herewith. It appears from von Schjerning's narrative that in May, 1918, there were 6,740 physicians of various grades and descriptions on active duty in the Zone of the Interior and

11,585 in the field, or a total of 18,325. During the whole period of the war, there were more than 24,000 physicians on military duty, of whom two-thirds served in the field and one-third in the home territory. Three thousand served with the Red Cross. There were also 600 dentists and 1,800 apothecaries. Of these, 24,000 physicians, 1,325 or 54.2 per thousand of the total strength, lost their lives; of these 562 were killed in battle, and 763 died of disease; 2,149 physicians were wounded and 467 missing. As compared with our own large mobilization of medical officers, the comparatively small numbers of physicians employed in an army of 11,000,000 men may be explained by the fact that the German forces had relatively short lines of communication as compared with our own, which extended not only over the length and breadth of the United States but some 3,000 miles overseas. Furthermore, some fifty years of careful preparation counted for much, since it was possible, in this length of time, to block out specific duties for every medical man capable of rendering public or military service in a prospective war. As a matter of fact, it was an outstanding feature of the German medical organization, that for the most part, physicians engaged in scientific work at the great university clinics, in the many institutions of scientific medicine in which Germany abounds, and in other public or academic avocations, were not removed from their home towns but continued their ordinary duties, enjoying the advantage that the sick and wounded could easily be brought up to them from railhead at the front. Thus both the physicians and their soldier patients had the advantage of the fully equipped personnel of well organized university hospitals or clinics, a condition which was determined in advance by the relatively short lines of communication. As in France, the whole medical profession of Germany was liable to war duty. In our own medical mobilization, we had to make up the time lost through lack of preparedness by attempting to accomplish the work of years in unit time, by means of a greatly expanded medical personnel; and our preparations had to be made in view of the possible continuance of the existing war for many years. No comparison could therefore be fairly made between the two conditions. As compared with our own losses in the Medical Corps, 182, the German mortality was excessively high (1,325 for four years, 332 per annum).[1] The total losses of the German Army up to May, 1919 were 6,888,870, of which 1,686,061 were losses by death (1,531,048 killed in battle; 155,013 died of disease), while 4,211,469 were wounded and 991,340 were missing.

[1]This statement will not seem exaggerated when we consider that the maximum personnel of officers in the German Medical Corps was 24,000 plus for an army of eleven millions, while we had, on November 30, 1918, a personnel of 30,591 medical officers for an army of about four millions.

Our own figures were 52,423 killed and died from wounds, 50,174 died of disease, out of a total loss of 318,993. The German losses were, therefore, over twenty times as heavy. Out of an army which averaged over 5,000,000 men in the four years of the war, no less than 19,461,264 men were reported sick, which shows the enormous difference between the actual totality of sick, between given periods, and the number of cases which have reported repeatedly to hospital. The figures of those returned from hospitals to the front as fit for duty are highly creditable, rising from 88.7 per cent in the first year of the war to 92.18 per cent in the fourth year. Nearly ten times as many men were killed in battle as died of disease. Von Schjerning notes that, in the list of casualties, gunshot wounds and fractures take the lead, while tonsillitis and diseases of the stomach and intestines take second place; infectious diseases presenting themselves at very moderate rates. The preponderance of gastro-intestinal diseases is very striking and was no doubt due to the defective food supply of the Central Powers. As everywhere, the epidemic of Spanish influenza caused the curve of infectious diseases to rise during the last year of the war. As might be anticipated, venereal infection was found to be relatively greater among troops in the home territory than among troops in the field. The increase was from 39,228 cases (15.2 per thousand total strength) in the first year of the war to 101,464 (20.2 per thousand total strength) in the last year. On the other hand, tuberculosis, which showed an enormous increase in the Zone of Interior (85 per cent in the larger cities), displayed a marked decrease in the field armies, due to the hardening of personnel through bodily exercise and life in the open air. By the fourth year of the war, the incidence of tuberculosis in the entire army had decreased from 7,166 (2.8 per 1,000 total strength) to 3,929 (.78 per 1,000 total strength). There is, therefore, no exaggeration in von Schjerning's statement that the open air life at the front created a huge power of resistance, indeed an almost hard and fast immunity against tuberculosis. Ample provisions for post mortems were made, resulting in the collection of over 7,000 preparations, with protocols and clinical histories. This attention to pathology was in striking contrast with English and American experience, which demonstrates the definite decline of gross pathology in these countries and the actual need for personnel with previous experience in making post mortem examinations. This phase of medical preparedness is also what might have been anticipated in a country where pathology has been so ardently followed and as part of the German program of preparation for the war.

Yet in spite of this long standing advantage in preparedness, and in view of the enormous sick list, the number of wounded in battle and the

number who died from wounds and disease, it is doubtful if the German Army enjoyed the medical and hygienic advantages of the Allied Armies, and while the achievement on the scientific side is impressive, the settlement of questions of priority in regard to many discoveries claimed for German medicine by von Schjerning, will be difficult of adjustment. Something, no doubt, was learned from the experience of the allies. At the start, the German military authorities seemed to have been able to differentiate clearly between military and scientific secrets which should be carefully withheld, especially from the enemy, and information (of whatever kind) which may be disseminated with impunity. It is said that the medical periodicals, newspapers, etc., of the Allied Powers were freely and openly on sale in the larger German cities.

While von Schjerning's introduction, as subjoined, has a somewhat listless and colorless character, as if he were discouraged and disillusioned by the events subsequent to the war (under present conditions, he does not even use his military grade), its utterly impersonal character is to be otherwise highly commended. He indulges in no vituperation or criticism of the Medical Services of the Allied Powers and preserves throughout the consistent, impartial, impersonal attitude, which should characterize the true follower of medical science at all times and places. Very worthy indeed is the fine professional spirit everywhere apparent in his narrative, as of one who affirms himself to be, first of all, a physician; while his utterances as to the enormous teaching value of military experience in war time for our profession, whether in the acquisition of scientific knowledge or in the strengthening of character, will be confirmed by all fair-minded physicians whose privilege it has been to serve our own country as medical officers during the recent war.

F. H. Garrison.

THE ACTIVITIES AND ACHIEVEMENTS OF MEDICAL OFFICERS OF THE GERMAN ARMY DURING THE WAR: INTRODUCTION TO THE "HANDBOOK OF MEDICAL EXPERIENCES IN THE WORLD WAR"

By OTTO VON SCHJERNING[1]

Chief Surgeon in the Field

The great world war, which occupied the space of time between August 2, 1914, and November 11, 1918, is at an end. Given its unfavorable outcome for Germany, a fateful catastrophe was unavoidable; it resulted in a grave political and economic crisis for our country in which the mental, emotional and moral traits of part of our people revealed themselves, alas! in an evil light. It is easy to understand, therefore, now that a compulsory peace has closed its doors upon war, that, no one would

[1]Translated by Lieut. Col. F. H. Garrison, M. C.

gladly lift the curtain again, and that any recollection of the war will be regarded as hateful. And yet it is our duty to show this war in the full light, since, in a manner, it has had for us its beneficent side and the word of Heraclitus, πόλεμος πάνῖον πατήρ (War is the father of all things) has its application to this unhappy war also. It has compelled us to see ourselves and to deal with ourselves as we really are; to smite our own breasts and to descend from the high cothurnus upon which we strode about the stage in such an unjustifiable manner; only thus can we again see ourselves and our own work in the true light. Through bitter want and misery, it has led us to scientific discoveries and inventions, which will be of overwhelming importance in our future national existence; it has widened and deepened the knowledge and the vision of the nations and has opened out to us new modes of transportation and unsuspected means of communication, in short, it has engendered advances in culture, which, for the future, will be of incalculable value. The tremendous and tragic occurrences, which the war has brought with it, are changing and ripening the national spirit and are giving it a new measure for the judgment of things. So we now find ourselves more receptive and more inclined to a critical matter-of-fact judgment of the phases of progress which the war has brought to us. To be sure, our judgment of things is not as yet certain in all respects nor is it stable; whether an attainment will be a permanent one or whether a given fact is to be finally numbered among the real treasures of our experience, remains to be seen. On every side, feelings of hate, envy and revenge are also in the ascendancy and no objective judgment can be formed as to what has been accomplished. But this will come in time.

Of the sciences, chemistry and medicine have undoubtedly done most for us; sustained, as they have been, by technical procedures, they have conquered far-reaching territories and occasioned investigations never before dreamed of. In its tremendous conquests and results, medicine was especially brilliant and to give an account of its contributions for the advantage and welfare of humanity to the healing of the sick, to the prevention of disease, and as a monumental memorial of the glorious self-sacrificing activities of the medical profession, is the purpose of this work. This war has added a laurel leaf to the history of medicine and on a plane with the heroic deeds of our army and of our soldiers, shine the achievements of our physicians, who deserve to be sung as once the Homeric heroes, Machaon and Podalirius, of whom one was famed for the ease with which his hand could cut out arrows from the flesh and heal every wound, while the other was able to recognize invisible ailments and to treat diseases believed to be incurable.

Certainly our physicians, too, were occasionally guilty of faulty treatment, errors in diagnosis and malpractice—to err is human—but everywhere an exalted sense of duty was recognizable and there was always evidence of humanity and warmth of heart in the treatment of patients. For more than four years, all told, most of the physicians fulfilled their duties day by day, in ample measure. In a hail of bullets they stood manfully to the assistance of the great press of the wounded, they cared for the sick with every device known to the art of medicine and continually they sought to hinder the occurrence of disease and the spread of epidemics. In wind and weather, in storm and night, they performed every duty, exposed themselves to the danger of infection, to all climatic hardships, to cold and snow in the east and the north, to the heat of the tropics, with its evil consequences in the desert regions of Macedonia, Turkey and Asia Minor. What self-sacrifice, what courage, what unselfish devotion have these years of medical activity to reveal! Only from this viewpoint can we comprehend why the losses among the medical officers were so uncommonly high; that death claimed 1,325 physicians, that is, 54.2 per 1,000

of the total strength and that of these alone 562 or 23 per 1,000 fell in battle or died of wounds, and 763 or 31.2 per 1,000 succumbed to diseases; 2,149 physicians were wounded and 467 are missing. And almost every day brought forth new exacting tasks for medical officers.

Directly upon the outbreak of the war, the greater part of the medical profession was compelled to learn how to live in military surroundings entirely unfamiliar to most of them, to get used to an entirely new environment and to become acquainted with the modes of transportation, and shelter as well as the medicines and medical matériel peculiar to military conditions. And then began at once the great avalanche of the wounded and sick. Like a torrent was the forward advance into Belgium. There and in northern France and Alsace, fighting was continuous and simultaneously the transportation of the wounded back into the home zone began. The rule was that only those were kept behind who could not be transported or whose wounds could be healed in a very short time. All the rest went by the 238 hospital trains into Germany. The first period of the war included all fighting up to the battle of the Marne, then began the trench warfare in northern France, western Belgium and Flanders. This period is remarkable on account of the innumerable wounded, of whom the number of those injured by explosive shells is astounding; it is also notable for the beginning of attacks of tetanus in gunshot wounds, especially in northern France, and then by the appearance of typhoid fever and dysentery in the region of Metz and Champagne. It was rapidly verified in experience that certain localities, in particular manured fields, favored the development of tetanus, being a culture medium for its bacillus, and that the introduction of tetanus serum injection very soon availed to protect from the infection after the wounds had occurred. As rapidly as traumatic tetanus fell upon us, all the more rapidly were we able to prevent it and to obliterate the frightful pictures which characterized the tetanus cases in military hospitals. At my instance, Behring was early decorated with an iron cross for this work, as also Röntgen on his seventieth birthday, for his discovery, which has been of benefit to thousands and thousands of the sick and wounded.

In the meantime, the war went on in the east, on the Russian frontier, in Poland, and in Russia itself, and in this region brought typhoid, dysentery and then typhus fever, which until then was unknown to most of our physicians. And with the passing of the spring of 1915 and the advent of summer, came the cholera, which brought with it new problems for medical officers. Against typhus and cholera, all of us fought with every known hygienic means and we introduced a prophylactic inoculation of serum, so that our troops were vaccinated against smallpox with vaccine, and against typhus and cholera with typhus and cholera serum, a precaution to which I am inclined to ascribe the rapid decrease in typhoid in northwestern France and the light incidence of cholera and typhoid in the Russian war zone. Against dysentery in the East, vaccination with polyvalent sera was undertaken, as to the success of which opinion is still divided. In order to protect the Zone of the Interior from contagious disease, it was ruled and made compulsory that no convalescent from typhus or dysentery should be invalided home to Germany, and even where a furlough was found to be necessary after his convalescence, his return home was conditioned by most careful disinfection of all of his belongings. On the Eastern front, from Edytkuhnen to Rosenheim, 18 stations were established, in which "cleansing institutions" or so-called delousing stations were built for the disinfection of all uniforms, knap-sacks, etc., for the bathing of officers and enlisted men, so that before passing into German territory westward from the east, a complete personal cleansing of individuals and destruction of all pathogenic germs was

carried out. These stations were so arranged that, taken by and large, 100,000 men with their effects daily could be cleansed and, at the same time, these men were bathed and their clothing was disinfected. In this way, the convection of disease from Russia to the home country, and to the Western front and westward, was prevented. On the Western front there were only a few cases of typhus fever, which were combatted as soon as observed, so that the disease was throttled at the source. In the West, convalescents from dysentery and typhus fever who were in need of further rest, were assembled at Spa, where they continued their recovery, until they were ready to rejoin their regiments.

In 1916, the trench warfare in Flanders and northern France was interrupted by the offensive against Verdun, where medical officers became well-acquainted with gas edema (gas phlegmon), which continued to menace the army, not only in the Somme offensive but in the Aisne and almost up to the end of the war. The disease derives its name from the accumulations of gas which are formed underneath the skin as products of inflammation and can be distinctly felt, indeed, were even found to be represented underneath the skin in Roentgen pictures of the wounded. Gas gangrene, a most deadly disease, compelled us to study its origin and to make extensive experiments toward its prevention; these resulted in a mode of treatment, which, unfortunately, only reached, in the last period of the war, the perfection that might result in complete cure.

The winter period in Flanders, with its damp trenches, and the cold of the Eastern front, brought on innumerable cases of frost bite and made the medical officers acquainted with frost gangrene in all its forms. In 1917, we have the same experience in wounds and diseases, both on the Eastern and Western frontiers. The only additional feature was the five-day fever of Volhynia, which appeared later in Flanders, whenever troops were changed from the East to the West. In the meanwhile, Bulgaria and Turkey began to participate in the war and the campaign against Roumania was begun. This campaign made us acquainted with the blood diseases dominating in Roumania, *e. g.*, scurvy, etc. The poor conditions of food supply and nutrition occasioned starvation edema and similar disorders of nutrition. Trench nephritis appeared in the East and perhaps even more in the West. The more the war was waged by us south of the Danube, the more malarial fever was in evidence, and physicians and medical officers became acquainted with its most varied forms. In the army itself, the variable results of quinine prophylaxis of malaria played a great part, especially in Constantinople, in Asia Minor and Macedonia. Dengue fever and Pappataci fever also became known.

America entered the war, and, in 1918, the Western offensive began. And as a new phenomenon, paratyphoid infection became severe in the West, particularly in Flanders; and Weil's disease (spirochaetal jaundice) in the Aisne region afforded an opportunity to become acquainted with its pathogenic parasite. At the close of the war, there began an epidemic of influenza, starting in Spain, which devastated all the armies and was accompanied by a disagreeable, often deadly, pneumonia. Even its course was longer than that of earlier epidemics, which usually began in the East and completed their course in the West. In addition, there was, in the larger cities, a full quota of venereal diseases which kept the medical officers especially busy. In Brussels, Warsaw and Bucharest, one incidence was particularly heavy, yet it is a fact not sufficiently well recognized that we succeeded in checking the general advance of venereal disease, in preventing its transmission into the home zone and in successfully treating most of the cases. In any case, the amount of venereal infection of the army within the home territory was relatively much larger than that

among troops in the field. In the last months of the war, diseases of the skin, particularly tinea, were on the increase and, being hard to heal and rapidly transmitted under war conditions, they were a severe tax upon the medical corps. An increase in intestinal parasites was also noticeable in the latter part of the war.

Bombs from aëroplanes and air attacks generally were a feature of the whole war period, but their effects became more formidable in the West toward the end of the war. Many physicians were struck and killed by projectiles from aëroplanes, some of them even while engaged in hospital and immediately under the protection of the Red Cross. Worthy of mention above all, are explosions by mines, the effects of great projectiles, poisoning by carbon monoxide in the dugouts, burial under earth-slides, which always had very demoralizing effects, shell-shock and war neuroses. The attacks by poisonous gases were particularly destructive; this mode of warfare was entirely new and had to be brought to the comprehension of physicians by special courses on the treatment and healing of gassed soldiers and on the prevention of gassing by means of gas masks.

Such was the field of medical activity and the background against which the achievements of the Medical Corps were thrown into relief. Some of the medical officers were engaged as regimental surgeons with troops and accompanied the soldiers on the march into quarters, into trenches and dugouts; others were actively engaged in the field sanitary formations, the sanitary trains and field hospitals; while a third group were employed in the base and evacuation hospitals and on the lines of communication. Hospitals had to be built from the ground up almost everywhere and many medical officers, who had never before had these experiences, acquired such skill and readiness in the construction of hospitals and shelters that these structures soon fulfilled all hygienic and economic requirements, particularly in the matter of water supply and drainage. A special value was attached to the bathing and disinfecting plants and with the increasing plague of vermin, delousing plants became an urgent necessity. In many places, special hospitals were erected and supplied with all requisite appliances and instruments; so also the hospitals for venereal diseases, the ophthalmic hospitals, which were often supplied with specially constructed magnets for the removal of iron splinters from the eye, the hospitals for ear disease, and the hospitals for nervous disease; indeed whole districts were set apart for nervous patients, who could then be utilized for every kind of work, and placed under the direct control of nerve specialists. There were also special hospitals for diseases of kidneys and diseases of the intestines, since the procedure necessary for the successful treatment of these people was better carried out in special rather than in general hospitals. Even for special surgical cases, *e. g.*, for fractures of the femur and cases of gas phlegmon, special hospitals, under direction of specially trained physicians, were erected.

In this regard, the best support given us by our country was in respect of completely appointed hospitals and in the great number of highly trained specialists, with whom successful treatment was a matter of course.

There were on the average more than 24,000 physicians in the service of the Army, of whom two-thirds served in the field and one-third were occupied at home; 3,000 physicians devoted themselves to the service of the Red Cross. In addition to the medical officers, there were 600 dentists and 1800 apothecaries. Toward the end of the war, the number of physicians decreased, and the losses through death and disease became at times quite high and even medical students had to be called to the colors as physicians. In May, 1918, there were altogether 18,325 physicians on active duty, of whom 6,740 served on home territory and 11,785 with the field armies.

All these men, particularly those in the field armies, have enlarged their knowledge and abilities and have widened their intellectual horizon through the war. Herein lies the blessing of war for physicians, in that they become stronger by training, richer through experience, and mightier in character, courage and ability. Special training in surgery, made itself memorable from the very nature of things. Strongly developed in resources, steadied in every way and acquainted with all the ills and necessities of war, the medical officers returned home from the war, bringing with them into civil life all these acquisitions in science, to the advantage of their fellow townsmen, whose confidence they have gained.

Under ordinary circumstances, a physician alone deals with the patient and his disease; in war time on the other hand, due to the close relation of personnel and the coöperative work in the military hospitals, there is an interchange of knowledge; nearly every case becomes a matter for consultation and the diagnosis and treatment are usually the result of a common interchange of thought. The causes of disease are also investigated and explored through coöperative investigation. And from these little councils, often held at the bedside, it was but a step to the larger and more frequent conferences and scientific addresses which took place in certain military districts and garrisons and from these to the great yearly assemblies of surgeons and internists and to the congresses of specialists, which were so successfully arranged for the advantage of science and proved so illuminative for all medical officers. In the great Central Headquarters of the West, we recorded meetings of medical officers, of advisory surgeons, of advisory internists and hygienists, for counsel on the prevention of typhoid, of dysentery, of preventive inoculation against typhoid, cholera and tetanus, of paratyphoid, in brief on all important questions bearing upon the protection of the health of the army and the prevention of the transmission of disease into the home territory. We held the first Congress of Surgeons at Brussels on April 7, 1915, the second meeting at Berlin on April 26-27, 1916, and the third again at Brussels on February 11-12, 1918; also a Congress of Internal Medicine at Warsaw on May 1-2, 1916;meetings of orthopedists and those interested in the care of the wounded at Cologne and Berlin, and a meeting of ophthalmologists at Heidelberg; a council on trench nephritis at the same university in October, 1916; sessions of the Scientific Senate at the Kaiser Wilhelms Akademie at Berlin, under my presidency, on July 26, 1917; meetings on the medico-military importance of nervous and psychic disorders due to the war, on malarial fever on January 30, 1917, and January 19, 1918; on gas edema on April 10, 1917, and December 22, 1917, on the proper lines for the medico-military consideration of nephritic patients on July 20, 1917, on preventive inoculation for dysentery on April 6, 1918, and many others. Among the subjects for consideration at the surgical congresses, the most prominent were: the indications for operative treatment at and behind the front, hemostasis, wound infection, gunshot injuries of the skull, of the chest, the abdomen, the arms and legs, as also the joints, the surgery of the vascular system; the ultimate effects of projectiles and their location in the body, gunshot wounds of the brain and nerves, the loss of the extremities, the sequels of gunshot wounds of the chest and abdomen, gunshot wounds of the larynx, the plastic surgery of the face and injuries of the jaws, protection from and prevention of gas edema, open wound treatment, antisepsis of the deep tissues by means of quinine derivatives, the manufacture of artificial limbs, positive and negative pressure in military surgery, gunshot wounds of the spinal cord, substitution products in military surgery, and also the transportation of the sick and wounded from the field. At Warsaw, we held council upon the protection of the army againt cholera, heart disease in soldiers, typhus fever and its epidemiology, typhoid and paratyphoid fever,

preventive inoculation against typhoid, dysentery, and trench nephritis. An unusual stimulus to the study of all these subjects was afforded by the close discussion of the most important war diseases and war injuries and this was further helped out by the excellent courses for advanced medical studies which were to be found everywhere in the large and small cities of the home country; through these courses, knowledge of the most important character was disseminated for the general good of all and proved a great blessing in the interest of our sick and wounded. This was apparent in the results of medical treatment. When we consider that the shelters of the sick in war time were only temporary or improvised shelters and that treatment in the home town and its hospital was always preceded by the tedious transportation from the field to the home zone, which often is injurious to the patient, we can only describe the results of treatment as astonishingly good or even brilliant. With each year of the war, the reports of medical treatment became more and more favorable. In the zones of the interior, of the advance, and the lines of communication there were returned as fit for duty:

88.7 per one hundred in the first year of the war (Aug. 2, 1914–July 31, 1915)
91.3 per one hundred in the second year of the war (Aug. 1, 1915–July 31, 1916)
91.8 per one hundred in the third year of the war (Aug. 1, 1916–July 31, 1917)
92.8 per one hundred in the fourth year of the war (Aug. 1, 1917–July 31, 1918)

These figures are so impressive that our medical officers can be well satisfied with the results of their endeavors. And while in the war of 1870-71, the number of those who died of disease (especially as a result of infectious diseases) far surpassed the number of those who fell in battle; the reverse was the case in the present war. As against 1,531,048 killed in battle, we had 4,211,469 wounded and 155,013 died of disease in our armies. This affords a notable indication of the good hygienic conditions in the German armies and of the activities of the medical officers not only in treatment of disease but in the prevention of the occurrence and recurrence of disease. It is worthy of note that, from recent computations, the average strength of our army was:

2,577,126 men in the first year of the war (August 2, 1914–July 31, 1915)
4,435,853 men in the second year of the war (August 1, 1915–July 31, 1916)
4,989,739 men in the third year of the war (August 1, 1916–July 31, 1917)
5,028,161 men in the fourth year of the war (August 1, 1917–July 31, 1918)

and that of these armies

3,942,904 or 1530 per thousand of total strength were sick in the first year of the war.

4,915,663 or 1188.5 per thousand of total strength were sick in the second year of the war.

5,043,730 or 1010.8 per thousand of total strength were sick in the third year of the war.

5,558,967 or 1105.6 per thousand of total strength were sick in the fourth year of the war.

19,461,264 total sick in the four years 1914–18.

Given such a rich array of clinical material, which was continually subjected to excellent medical observation and treatment, it will not seem strange that scientific findings of value should result from it. To be sure, not all these questions and particularly those which have to be solved or demonstrated by means of statistical tables, have yet been settled. The wealth of the collected material is so great that it will require the work of years and the most comprehensive talent to exhaust its

possibilities. Nevertheless, the scientific results of medical investigation of the war period can now be sketched out along broad lines.

The first fact to be established is that in all the four years of the war, among the different groups of disease and casualties, wounds from projectiles, in particular gunshot wounds and fractures (Group XII), make up the largest contingent; that inflammation of the tonsils and diseases of the stomach and intestines (Group V) come second; and that infectious diseases (Group I) present themselves at very moderate rates; only in the last year of the war do the figures in this group increase considerably, through the epidemic of influenza. Influenza alone caused in the four years of the war 708,306 cases of illness or 140.9 per 1,000 of the total strength. The venereal diseases amounted in the first year of the war to 39,228 cases or 15.2 per 1,000 total strength and rose in the last year to 101,464 or 20.2 per 1,000 total strength. Careful and scientific treatment of these diseases brought about recovery in nearly every case and prevented further spread of disease and infection, of which those at home, not properly esteeming the solicitude of our medical officers, were unduly fearful. Tuberculosis, which during the war, showed an enormous increase in the home population—the mortality from tuberculosis in our larger cities rose from 40,000 in the year 1913 to 74,000 in 1918 or 85 per cent—did not in the army attain to the slightest sign of any increase in mortality; on the contrary, a distinct decrease was noticeable. This experience indicates that our army demonstrated a huge power of resistance against tuberculosis and that the personnel had hardened itself in the most vigorous way, and through manifold bodily exertions and the continuous life in the open air, created for itself a hard and fast immunity from the disease. In the first year of the war, the cases of tuberculosis in the entire army amounted to 7,166 or 2.8 per 1,000 of the total strength, in the second year they came down to 6,865, in the third to 5,526 or 1.1 per 1,000 total strength and in the fourth year in continual decreasing progression to 3,929 or 0.78 per 1,000. In spite of the fact that the replacements of personnel were finally and from month to month almost unquestionably of poorer bodily vigor, many of those called to the colors had already been earlier treated in tuberculosis hospitals.

Of all our medical achievements, those in the field of ætiological findings seem to me the most brilliant and the most important. That we were able during the war to discover the cause of typhus fever and thus to investigate a disease which caused the greatest destruction not only in the army, but in the entire population of the Eastern front and which commonly spread with rapidity; that alone is a scientific achievement of the first rank. Let one merely reflect what a sacrifice typhus fever entailed upon the Napoleonic army in Russia in 1812, and one can realize how terribly our own army, which had never before suffered from typhus, would have been ravaged by this disease, if we had not succeeded in discovering its origin, in demonstrating its transmission by the louse and in establishing the fact that destruction of this vermin makes the spread of typhus fever impossible. To be sure, the true exciting cause has not yet been established with certainty, but the result of the knowledge of the relation of lice to the origin of typhus fever may be estimated from the fact alone that before this knowledge became known, hundreds of deaths took place from this disease in our prison camps, which had been invaded by typhus, but that after the vermin had been generally destroyed, the disease disappeared entirely.

Important, too, was the discovery of the five-day fever or Volhynian fever, which hitherto unknown, was first described as a pathological phenomenon through the investigation of German physicians. Another thing deserving of particular interest is the fact that the special cause of Weil's disease, that infection which begins with

jaundice and typhoid manifestations and is associated with bathing in water, was discovered during the war and found to be a spirochaete. Trench nephritis was also investigated as to cause; also paratyphoid infection; and furthermore, important investigations on the origin of the different modes of malarial fever were made. Advances in the knowledge of the causes of the wound infection were made from the most varied angles and extensive investigations were undertaken of the cause of gas gangrene in particular. Hunger edema, hardly known in Germany before the war, was exhaustively studied and ætiological interpretations were afforded of trichinosis, influenza, tuberculosis and finally even of the different manifestations of disease resulting from the various gas attacks.

As in the case of ætiology, so also, was great progress made in the matter of ways and means of ascertaining an exact diagnosis. The surgeons, in particular, from the enormous amount of material on hand and its importance, gained new ideas for the investigation of gunshot wounds of the abdomen and applied Roentgen technique in new forms, especially in stereoscopic photographs for the location of foreign bodies. Microscopic and cultural investigations lead to new experiences in the bacteriological diagnosis of the dysenteries, to the so important early diagnosis of syphilis by a demonstration of the spirochaete, and to progressive advances in the interpretation of wound infection. Through the same means, the diagnosis of malarial and relapsing fevers was put upon a definite basis. The Weil Felix reaction afforded a very useful diagnostic sign of typhus fever. On the other hand, as a result of preceding inoculation against typhoid, the agglutination test for typhoid lost its demonstrative power, which made the diagnosis of the disease more difficult.

Path-breaking in the field of prophylaxis were our experiences with preventive inoculation against infectious disease, in particular, typhoid, dystentery, cholera and paratyphoid. Attempts at inoculation for the attainment of immunity were even essayed against typhus fever and further experience was gained in regard to the manufacture of vaccines and particularly the choice of cultures. A gas-edema serum was made for the prevention of this disease and the obligatory application of preventive inoculation of tetanus-serum immediately after the wound, proved an endless blessing in the prevention of traumatic tetanus. One very important experience was the recognition and estabishment of the significance of "latent infection" in tetanus as well as in gas gangrene. In other words, since cases of light tetanus and gas gangrene were observed as a result of operations executed upon wounds, which had been healed for months, the conclusion was reached that tetanus and gas bacilli had been vegetating in a resting (spore) state in the former wounded tissues and their scars. Outbreaks of the disease were prevented by a prophylactic injection of serum, made before beginning the new surgical operation. As a means of disinfection, cyanic acid vapor took the place of blasts of steam, particularly in the destruction of vermin. Finally, equally novel experiences were made in the prevention of syphilis and gonorrhoea.

Among prophylactic measures, we may class, in a manner, the invention of steel helmets, which lessened the danger of gunshot wounds of the head, and the wearing of armor, which, however, for various reasons, was not carried into general use. Deserving of brief mention are also the many attempts at prevention of injuries of the tympanic membrane and of haemorrhage from the ear during the firing of guns of large caliber.

The advances made in therapeutics can only be sketched out in certain phases and along certain lines; an exact account of it would be out of place here, by reason of the very wealth of the material. What seem most outstanding are the results of

treatment of neurotics of the war, which brought these tremblers back to manhood and made them capable of carrying on work and taking a worthy part in life. Of particular importance would appear to be the results of nerve suture, which gave to many unfortunates the possibility of regaining the use of limbs mangled and paralyzed by gunshot wounds. All in all, the therapeutic results of surgery, compel our undivided admiration, and we may specify in particular the varied methods of wound treatment and the different modes of disinfecting wounds, such as the Carrel chemo-therapeutic method, local treatment with quinine derivatives (vuzin, eucipin) and so on up to the old, yet ever new, open method of wound treatment. We wonder at the manifold splints and bandages of all kinds which exercised the skill of the surgical artists, at the new operative procedures, which made possible the re-uniting and healing of mangled limbs, with the best possible restoration of function (the Hackenbruch brace, the Reh brace, nail-extension), or which prevented anklyosis of important joints (Payr's method). We marvel at the technique of prothesis which furnished a substitute for portions of limbs which had been shot away (the methods of Sauerbruch and Krukenberg) and we are astonished at the results of plastic surgery, among which plastic results on the face, and the healing of gunshot wounds of the jaws make the deepest impression, for these are to be recorded as the greatest surgical advances made in the war. In the extraction of portions of projectiles from wounded eyes with the aid of strong and even the most powerful magnets, the science of ophthalmology assembled a wealth of experience and was able to save many eyes otherwise destined to be lost. Through early enucleation and exenteration of the eyeball in badly mangled eyes, sympathetic inflammation of the eye, so frequently observed hitherto, has been almost entirely done away with, so that in this war its terrors have disappeared. The most recent devices of bacterial therapy and serotherapy have been extensively applied in internal medicine, in typhoid fever, dysentery, cholera (antigen treatment), in typhus fever and Weil's disease (reconvalescent serum), and at the close of the war, the surgeons acquired a practical serum for gas edema, as to the success of which we are not certain. Among the chemo-therapeutic procedures which arose in the war period, are the early treatment of syphilis by salvarsan, the abortive treatment of gonorrhoeal infection by silver preparations, the development of the so called "provocative method" in latent malaria and the effect of cystin preparations on carriers of typhoid fever. Special attention was devoted to the digitalis preparations; and an acquisition of special prominence was the dietetic treatment of dysentery and typhoid fever, which, in opposition to the starvation treatment hitherto employed, hastened recovery and restoration to health by means of a liberal diet instituted at the beginning of the second week. The psychiatrists established the marked decrease in alcoholic insanity during the war period.

In the field of pathological anatomy, it was a happy and fruitful thought to establish post-mortem stations in all the armies; in these, under the direction of the pathologist attached to the Chief Surgeon, work was carried on from definite viewpoints. Scientific protocols of post-mortem sections were written out and collections of important pathological preparations, now in the Kaiser Wilhelms Akademie in Berlin and in Munich and Vienna, were established and brought together. In the collection of pathological specimens of the war in the Kaiser Wilhelms Akademie there are over 7,000 preparations, with the protocols of the sections and, in many cases, with copies of the corresponding clinical histories. What material could be more excellent for purposes of investigation and study than this collection of war pathology, which has been increased by microscopic slides made by the best author-

ties? Through the wealth of the material obtained from the war and especially through its peculiar character, this collection has opened a wide field of activity for the pathologists, during the war as also for the years to follow. The forms of injury made by projectiles of the most varied kind are very different in character from the established forms of injury described in the literature of earlier wars. The preponderance of wounds from artillery projectiles is particularly apparent and even during the war itself, the difference was revealed, when the gunshot wounds, which were most frequent in the earlier stages of the war, were outnumbered by artillery wounds. Furthermore, new modes of warfare and novel injuries resulting from the introduction of technical improvements were observed. Bombs and hand grenades, explosions of mines, novel and most varied projectiles from infantry arms, the projectiles especially employed by the enemy, which in part are to be reckoned with the dum-dum bullets, all these occasioned peculiar modes of injury. To these must be added the injuries incurred in falling from aëroplanes, from burial in the earth and contusions of the severer types.

We must further consider the most recent kinds of destructive gases, the variable composition of which occasioned pathological manifestations of the most varied kind. In the department of internal disease and epidemic diseases, the pathologist again acquired an extensive, sometimes unusual, sometimes even unknown material for study. Trench nephritis, influenza, paratyphoid infection, Weil's disease, five-day fever, relapsing fever, scurvy, smallpox, typhus fever, malarial fever, hydrophobia, cholera, pellagra, leprosy, intestinal worm infection and many other diseases, brought to the pathologist a quantity and variety of material for investigation, such as has never before been the case.

The material of this war has been no less to the advantage of constitutional pathology. Never before has it been possible to make an anatomic investigation of such a large number of persons, who had suddenly died from wounds at the ripest period of manhood and in the best condition of health. Through this fact, it was possible to make comparative investigations in the greatest number. Through the special possibility of making an early post-mortem section, directly after death, in cases of severest injuries, *e. g.*, in destruction of the cranium and heart by gunshot wounds, it was possible to make most valuable observations of the normal conditions of the organs in human bodies still warm with life. The form of the systolic and diastolic heart, the form of the stomach in its different states of contraction and fullness, corresponding with the Roentgen appearances in the living, the appearance of the gastric mucous membrane in relief, the states of intestinal contraction, the relations of the rectum to the prostate and the seminal vesicles, have all been thoroughly studied.

Studies in ethnic anatomy have been made with reference to the very composite racial complexion of the armies of the enemy. Skeletal material and death masks of foreign peoples, in particular the Asiatic and African races, as also the Balkan populations, have been collected. Eunuchs and Roumanian castrates have been investigated and in some cases brought to post mortem.

Comparative measures of the length of the intestines have been made. Furthermore, an opportunity was also afforded to utilize the gigantic material in the question of the phthisical habit of body as also the general tuberculosis question, its frequency, localization and metastases. The dispute as to the justification of establishing a norm of the lymphatic constitution, the question of the status thymo-lymphaticus, have been considered, also abnormities and tumors, the question of the narrow aorta, syphilis, and the relation of the glands of internal secretion to one another. In aid

of medico-legal consideration of the psychic constitution, tattoo markings have been assembled in great numbers. Attention has also been directed, incidentally, to other problems, in particular wound infection and above all, gas edema and tetanus. The effect of vaccination upon the entire organism and the individual organs has been considered in detail. Special attention has been directed to all questions which relate to the cause of sudden death, to questions of injuries incurred in line of duty, uncertain diagnoses, remote effects and late sequelae of wounds and injuries.

Thus an endless array of pathological material has been assembled and investigated by our medical officers and the results of this accumulation of knowledge are now revealed in all branches and professions of the theory and practice of medicine. If Helmholtz could today examine and illuminate the progress of medicine, as he once did in his famous address on "Thought in Medicine" on foundation day at the Friedrich Wilhelms Institut in 1877, he would undoubtedly establish the fact that the once almost matronly countenance of Dame Medicine has in the last decades, and especially through and after the war period, taken on a more lively and youthful semblance and that her pulse beats with a stronger and more lifelike rhythm than in 1877.

It is our object to set forth in this work, every new achievement which has been made by our physicians in the science and art of medicine during the war period. May it be our good fortune to describe what has been accomplished in a great and worthy manner! Only then will this work be a lasting memorial to our medical officers; it will establish their glory, the success of their endeavors and their power of achievement, it will be of service for the emulation of coming generations and will advance and guard the interests of our science. So, therefore, may the thanks be rendered which I, as Chief of the Field Service of the Medical Corps in the war, at home and in the war zone, feel it to be my duty to pay to our medical officers for their willing and self-sacrificing labors and for their true loyalty to the Corps. May the future protect and be of advantage to medicine; may better political and economic times again follow for the disciples of Æsculapius than now exist; may the memory of the medical officers who have so gloriously fought and died in the war be held in lasting honor and may our country, which now finds itself in such a distressed condition, never forget what German physicians have faithfully and self-sacrificingly done for it in the darkest days of the war.

APPENDICES

TABLE 1.—*Losses of the German Medical Corps*

(From the lists of losses continued by the Medical Department up to January 10, 1919. In absolute numbers and in relation to total strength)

	Medical officers.								Field auxiliary and assistant surgeons		Civilian physicians, including those liable for duty in the Landsturm		Total	
	Active		Retired officers on active duty		Reserve officers recalled to duty		Reserve officers including approved acting assistant surgeons							
		Per 1000		*Per* 1000		*Per* 1000		*Per* 1000		*Per* 1000		*Per* 1000		*Per* 1000
Killed or died of wounds.	53	34	.....	.....	6	4	309	35	147	32.6	47	6	562	23
Died of disease or other causes	64	41.1	28	86.9	87	57.5	326	37	107	23.7	151	19.5	763	31.2
Total.....	117	75.1	28	86.9	93	61.5	635	72.1	254	56.3	198	25.5	1325	54.2

TABLE 2.

In May, 1918, there were on duty:

(*a*) *In the Zone of the Interior:*

42	Surgeons General.
103	Deputy Surgeons General (Division Surgeons).
698	Surgeons Major.
1,825	Regimental surgeons.
1,225	Battalion surgeons.
16	Approved assistant surgeons.
1,594	Acting battalion surgeons (from civil life).
289	Acting assistant surgeons (from civil life).
333	Auxiliary field surgeons.
615	Assistant field surgeons.
Total...6,740	Medical officers.

(*b*) *In the Armies in the Field:*

11,585	Medical officers.
Total..18,325	Medical officers.

TABLE 4.—*Losses of the German Army from the Lists of German Losses Published up to the End of May, 1919*

	Officers	Officials	Acting as officers	First sergeants	Sergeants	Petty officers	Privates	Total
1. Killed.....	45,123	762	7,402	31,734	15,261	122,812	1,307,954	1,531,048
2. Missing.....	17,215	66	2,794	19,106	19,311	69,510	863,338	991,340
3. Wounded....	91,679	499	16,870	89,192	49,090	330,013	3,641,126	4,211,469
4. Died of disease, etc...	3,903	543	477	2,785	2,233	7,778	137,294	155,013
Total.....	157,920	1,870	27,543	135,817	85,895	530,113	5,949,712	6,888,870
Total mortality.....	49,026	1,305	7,879	34,519	17,494	130,590	1,445,248	1,686,061

1. "Officers" include sanitary and veterinary officers.
2. "Officials"=chiefs and subaltern officials.
3. "First sergeants" include surgeons and veterinarians' assistants.

TABLE 3.—*Losses to the Service of Officers and Men of the German Field Army, Treated in the Hospitals of the Zone of the Interior, at the Front and on the Line of Communication (Computed per 100 of the Permanent Withdrawal).*

In the	Home territory			Front and line of communication			Zone of interior, advance and line of communication			Army of occupation hospital patients		
	Dutiable	Died	Otherwise withdrawn	Dutiable	Died	Otherwise withdrawn	Dutiable	Died	Otherwise withdrawn	Dutiable	Died	Otherwise withdrawn
First year of the war, to Aug. 31, 1915	89.4	1.7	8.9	86.7	10.2	3.0	88.7	4.0	7.3	92.2	1.2	6.6
Second year of the war, to Aug. 31, 1916	91.1	1.0	7.9	91.9	6.2	1.9	91.3	2.8	5.9	89.1	1.1	9.7
Third year of the war, to Aug. 31, 1917	90.1	1.1	8.8	94.1	4.6	1.3	91.8	2.6	5.6	87.8	1.5	10.7
Fourth year of the war, to Aug. 31, 1918	90.9	1.2	7.8	94.7	4.4	0.9	92.8	2.8	4.4	88.6	2.0	9.4

1. Dutiable = Fit for combatant service, for garrison duty or as laborers.

2. Otherwise withdrawn = Furloughed, deserted, and unfit for service with or without pension. Many of the furloughed and of those sent to health resorts, became later on again fit for service, so that the figures of those fit for service are a little higher than given above.

3. Although not all the hospital reports of the Field Army, upon which these computations are based, are as yet available, yet the mass of these reports which has already been prepared and submitted is so nearly complete that no essential changes in the percentages here given need be apprehended.

4. Permanent withdrawal = Hospital patients permanently withdrawn from treatment, *i. e.*, exclusive of patients transferred to other hospitals.

Table 5.—*Records of Patients Admitted to Hospital from the German Army According to the Sick and Wounded Reports.*

Admissions per year of war (per 1000 = in terms of average actual strength per year)	Average actual strength during period of report (including officers, sanitary and veterinary officers and officials)	Group I														Group II
		Smallpox	Scarlatina	Measles	Diphtheria	Typhoid fever	Typhus fever	Intermittent fever	Influenza	Tuberculosis	Dysentery	Asiatic cholera	Rheumatic fever	Heat stroke	Other infections and general diseases	Diseases of nervous system
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
First year	2,577,126	18	469	180	603	14042	81	417	86320	7166	6971	944	65514	2794	24738	60813
Per 1000		0.01	0.01	0.07	0.23	5.4	0.03	0.16	33.5	2.8	3.7	0.37	25.4	1.1	9.6	23.6
Second year	4,135,853	39	615	291	2388	5423	442	4480	212156	6865	7983	914	75123	809	31435	88697
Per 1000		0.01	0.15	0.07	0.58	1.3	0.11	1.1	51.3	1.7	1.9	0.22	18.2	0.2	7.6	21.4
Third year	4,989,739	42	518	311	2887	2555	963	23831	226398	5526	11945	117	49790	660	32156	85912
Per 1000		0.01	0.1	0.06	0.58	0.51	0.19	4.8	45.4	1.1	2.4	0.02	10.0	0.13	6.4	17.2
Fourth year	5,028,161	74	404	208	3646	3536	1415	49942	708306	3929	20796	65	40374	451	35653	77915
Per 1000		0.01	0.08	0.04	0.73	0.7	0.28	9.9	140.9	0.78	4.1	0.01	8.0	0.09	7.1	15.9

TABLE 5.—*Continued.*

Admissions per year of war (per 1000 = in terms of average actual strength per year)	Average actual strength during period of report (including officers, sanitary and veterinary officers and officials)	Group III			Group IV		Group V					Group VI	Group VII	Group VIII		Group X
		Pneumonia	Pleurisy and sequelae	Other respiratory affections	Diseases of heart	Diseases of blood-vessels and hematopoetic system	Tonsillitis	Diseases of mouth, pharynx, œsophagus and salivary glands	Diseases of stomach and intestines	Abdominal hernia	Other diseases of digestive system	Diseases of genito-urinary system (exclusive of venereal)	Venereal diseases	Infections of eye	Other eye diseases	Ear diseases
		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
First year.....	2,577,126	17124	19318	330770	82845	23658	77599	114768	589920	34324	34695	45715	39228	1653	66566	64665
Per 1000.....		6.6	7.5	128.3	32.1	9.2	30.1	44.5	228.9	13.3	13.5	17.7	15.2	0.64	25.8	25.1
Second year....	4,135,853	16471	24782	426630	100898	39371	98907	174871	671839	52437	61356	95259	65425	1472	98172	98799
Per 1000.....		4.0	6.0	103.2	24.4	9.5	23.9	42.3	162.4	12.7	14.8	23 0	15.8	0.36	23.7	23.9
Third year.....	4,989,739	18018	24658	447642	74826	40294	92682	179754	775044	39529	56145	106306	77196	1275	95743	93156
Per 1000.....		3.6	4.9	89.7	15.0	8.1	18.6	36.0	155.3	7.9	11.3	21.3	15.5	0.26	19.2	18.7
Fourth year....	5,028,161	15761	31284	365783	58929	40739	88694	140380	781963	31697	41780	108947	101464	904	84819	80923
Per 1000.....		3.1	4.2	72.7	11.7	8.1	17.6	27.9	155.5	6.3	8.3	21.7	20.2	0.18	16.9	16.1

TABLE 5.—*Continued.*

Admission per year of war (per 1000 = in terms of average actual strength per year)	Average actual strength during period of report (including officers, sanitary and veterinary officers and officials)	Group X		Group XI		Group XII				Group XIII	Group XIV	Total	There are included under No.				
													14	14	15	26	39
		Diseases of skin, etc.	Panaris	Diseases of bones and joints	Diseases of muscles	Gunshot wounds	Wounds from *Armes blanches*	Fractures, sprains and dislocations	Other wounds and injuries	Other diseases	Under observation		Tetanus	Weil's disease	Insanity	Nephritis	Gassing
		31	32	33	34	35	36	37	38	39	40	41					
First year.....	2,577,126	363194	38021	85491	210068	950214	20346	126112	149201	144723	41616	3942904	..	....	....	....	....
Per 1000.....		140.9	14.8	33.2	81.5	368.7	7.9	48.9	57.9	56.2	16.1	1530.0					
Second year.....	4,135,853	615194	51141	100134	289746	761730	6049	152518	226645	169995	78162	4915663	4	7	9	1292	6178
Per 1000.....		148.7	12.4	24.2	70.1	184.2	1.5	36.9	54.8	41.1	18.9	1188.5	..	....	....	0.31	1.5
Third year.....	4,989,739	699356	46991	90420	262171	726073	3607	149338	258027	160975	80893	5043730	10	108	30	3058	19164
Per 1000.....		140.2	9.4	18.1	52.5	145.5	0.72	29.9	51.7	32.3	16.2	1010.8	..	0.02	.01	0.61	3.8
Fourth year.....	5,028,161	748250	43591	78162	236455	894638	2811	138114	242145	176492	87528	5558967	3	55	8	2600	53321
Per 1000.....		148.8	8.7	15.5	47.0	177.9	0.56	27.5	48.2	35.1	17.4	1105.6	..	0.01	....	0.52	10.6

TABLE 6.—*Records of Admission to Hospital of the German Army Arranged by Groups af Diseases and Injuries (I-XIV).*

Admissions per year of war	Group I Contagious and general diseases	Group II Diseases of nervous system	Group III Diseases of respiratory organs	Group IV Diseases of circulatory organs and blood	Group V Diseases of digestive organs	Group VI Diseases of genito-urinary organs	Group VII Veneral diseases	Group VIII Diseases of eye	Group IX Diseases of ear	Group X Diseases of skin, etc.	Group XI Diseases of locomotive organs	Group XII Wounds and injuries	Group XIII Other diseases	Group XIV Under observation	Total
First year	210257	60813	367212	106503	851306	45715	39228	68219	64665	401215	295559	1245873	144723	41616	3942904
Per 1000	81.6	23.6	142.5	41.3	330.3	17.7	15.2	26.5	25.1	155.7	114.7	483.4	56.2	16.1	1530.0
Second year	348963	88697	467883	140269	1059410	95259	65425	99644	98799	666335	389880	1146942	169995	78162	4915663
Per 1000	84.4	21.4	113.1	33.9	256.2	23.0	15.8	24.1	23.9	161.1	94.3	277.3	41.1	18.9	1188.5
Third year	357699	85912	490318	115120	1143154	106306	77196	97018	93156	746347	352591	1137045	160975	80893	5043730
Per 1000	71.7	17.2	98.3	23.1	229.1	21.3	15.5	19.4	18.7	149.6	70.7	227.9	32.3	16.2	1010.8
Fourth year	868799	77915	402828	99668	1084514	108947	101464	85723	80923	791841	314617	1277708	176492	87528	5558967
Per 1000	172.8	15.5	80.1	19.8	215.7	21.7	20.2	17.0	16.1	157.5	62.6	254.1	35.1	17.4	1105.6

TABLE 7.—*Amounts of Sera and Vaccines Used for Preventive Inoculation.*

Tetanus serum	10,050,000	preventive inoculations.
	85,389	curative injections.
Diphtheria serum	200,000	flasks.
Smallpox lymph	12,615,000	doses.
Meningitis serum	395	liters.
Dysentery serum	7,130	liters.
Dysentery vaccine	1,345	liters.
Typhoid vaccine	103,360	liters.
Paratyphoid vaccine	940	liters.
Cholera vaccine	79,821	liters.
Cholera serum	122	liters.
Gas edema serum	5,655	liters.
Normal horse serum	48	liters.
Pneumococcus serum	24	liters.
Staphylococcus serum	30	liters.
Streptococcus serum	210	liters.
Gonococcus serum	49	liters.
Plague vaccine	32	liters.
Plague serum	98	liters.

PLAN OF THE GERMAN MEDICAL HISTORY OF THE WAR

VOLS. 1-2.—MILITARY SURGERY (Editors: Prof. Erwin Payr and Prof. Carl Franz), 1,500 pp.

A. General Section

I. (*a*) Offensive Measures in the World War and their Effects upon the Body and its Tissues. Firearms, Ordinary Projectiles (Dr. Fritz Brüning).

(*b*) Indirect Injuries. Indirect Gunshot Wounds, Air Pressure in Explosions. Earth-Slides, Precipitation from Aeroplanes (Prof. F. F. O. Kayser).

II. General Sequelae of War Injuries: (1) Pain, its Relief and Prevention (Prof. A. Läwen); Hemorrhage, Loss and Replacement of Blood; (3) Shock, its Nature and Treatment; (4) Death (Death on the Battlefield, Cataleptic Rigidity) (Dr. Curt Heinemann).

III. Wound-Infection, Its Prevention and Treatment (Prof. A. Läwen and Prof. Georg Schöne).

IV. Impacted Foreign Bodies and Their Removal (Prof. A. Tietze and Prof. H. Heineke).

V. Transportation of the Wounded (Concept of Transportability) (Prof. Carl Franz).

B. Special Section

I. Gunshot Wounds of the Head and Face: (1) Injuries of the Cranium and their Complications (Prof. Fedor Krause and Prof. Erwin Payr); (2) Late Sequelae of Brain Injuries (Prof. Otto Hildebrand); (3) Gunshot Wounds of the Face and Injuries of the Jaws (Prof. R. Klapp, Prof. H. Schröder and Prof. O. Römer).

II. Gunshot Wounds of the Neck (Prof. V. Schmieden).

III. Gunshot Wounds of the Spinal Cord, Spine and Sacrum (Prof. Anton von Eiselsberg).

IV. Gunshot Wounds of the Chest; Gunshot Wounds of the Lungs, Heart, Diaphragm, Chest and Abdomen (Prof. L. Rehn, Prof. F. Sauerbruch, Dr. W. Jehn).

V. Gunshot Wounds of the Abdomen: (*a*) Wounds of the Stomach and Intestines (Prof. E. Enderlen); (*b*) Wounds of the Liver, Spleen and Pancreas (Prof. Werner Körte).

VI. Gunshot Wounds of the Genitourinary Organs (Prof. H. Kümmell and O. Rumpel).

VII. Gunshot Wounds of the Extremities, Exclusive of the Joints (Prof. W. Müller, Prof. C. Franz, Prof. M. Martens, and Prof. K. Pochhammer).

VIII. Gunshot Wounds of the Joints (Prof. H. Küttner and Prof. F. Landois).

IX. False Joints (Prof. N. Guleke).

X. Injuries of the Blood Vessels (Prof. A. Bier and Prof. H. Grauert).

XI. Injuries of the Nerves (Prof. G. Perthes, Prof. M. Borchhardt and Prof. R. Cassirer).

XII. Technics of Amputations, Resections, etc. (Prof. H. von Haberer).

XIII. Plastic Operations and Free Transplantations in Aid of Reconstructive Surgery (Prof. Erich Lexer).

XIV. Artificial Limbs (Prof. F. Sauerbruch and Prof. K. Ludloff).

XV. Medico-mechanical and Operative Treatment of Contractures and Ankyloses (Prof. F. Lange and Prof. M. Kirschner).

Vol. 3.—Internal Medicine (Editor: Prof. Ludolf Krehl), 900 pp.

A. General Section

General Effects of the Campaign upon Bodily Health (Prof. Wilhelm His).

B. Special Section

I. Infectious Diseases.

(*a*) Typhoid and Paratyphoid Infection (Prof. R. Stintzing and Prof. A. Goldscheider).

(*b*) Sequelae of Typhoid and Paratyphoid Infection (Prof. P. Krause).

(*c*) Dysentery (Prof. A. Schittenhelm).

(*d*) Cholera (Prof. Wilhelm His).

(*e*) Weil's Disease (Prof. F. Buttersack).

(*f*) Typhus Fever (Prof. G. Jürgens).

(*g*) Relapsing Fever and Similar Diseases (Prof. O. Rostoski).

(*h*) Smallpox (Prof. A. Besserer).

(*i*) Malarial Fever (Prof. L. Brauer and Prof. A. Schwenckenbecher).

(*j*) Cerebro-Spinal Meningitis (Prof. P. Morawitz).

(*k*) Diphtheria (Prof. C. Schlayer).

(*l*) Influenza (Prof. F. Münter).

II. Trichinosis (Prof. M. Matthes).

III. Effect of Poisonous Gases (Prof. O. Minkowski).

IV. Diseases of the Upper Air Passages, the Lungs and the Pleura (Prof. F. Penzoldt and Prof. L. Brauer).

V. Diseases of the Heart and Blood Vessels (Prof. F. Kraus and Prof. A. Hoffmann).

VI. Diseases of the Mouth and Stomach (Prof. D. Gerhardt).

VII. Diseases of the Intestines, the Liver and the Peritoneum (Prof. M. Matthes).

VIII. Diseases of the Kidneys (Prof. C. Hirsch).

IX. Diseases of the Bladder and Disorders of the Urination (Prof. L. R. Müller).

X. Disorders of Metabolism, Lowered Nutrition (Prof. H. Strauss).

XI. Diseases of the Blood: Scurvy (Prof. J. Grober).
XII. So-called Rheumatic Affections (Bones, Joints, Nerves) (Prof. H. Dorendorf).

Appendix. Special Clinical Observations.

(*a*) From the Balkan Theater of War (Prof. L. Brauer).
(*b*) From the Turkish Theater of War (Prof. H. Selling).

VOL 4.—NERVOUS AND MENTAL DISEASES (Editor: Prof. Karl Bonhoeffer), 500 pp.

A. Psychoses and Psycho-Neuroses

I. The Significance of War Experiences for General Psychopathology and the Aetiology of Mental Diseases (Prof. K. Bonhoeffer).
II. Hysteria (Prof. Otto Binswanger).
III. Shell-Shock and Neurasthenia (Prof. R. Gaupp).
IV. Psychotherapeutic Results in the Treatment of War Neuroses (Prof. R. Wollenberg and Prof. Max Nonne).
V. Psychopathic Constitution (Prof. G. Aschaffenburg).
VI. Epilepsy (Prof. Konrad Alt).
VII. Adjudication of Pensions in Soldiers Affected with Nervous and Psychic Disorders (Prof. E. Stier).

B. Organic Injuries of the Nervous System

I. Gunshot Injuries of the Brain in Relation to Cerebral Localization and Cerebral Pathology (Prof. K. Kleist).
II. Late Clinical Sequelae of Gunshot Wounds of the Brain (Prof. E. Forster).
III. Exercise as a Remedy in Gunshot Injuries of the Brain (Prof. W. Poppelreuter).
IV. Gunshot Injuries of the Spinal Cord and the Peripheral Nerves (Prof. O. Förster).

VOL. 5.—OPTHALMOLOGY (Editor: Prof. M. Axenfeld), 600 pp.

A. General Section

I. Incidence and Care of War Injuries and Diseases of the Eye, Wound Infection and Wound Treatment (Prof. M. Axenfeld).
II. Opthalmological Experiences at the Front and in Field Hospitals (Prof. W. Gilbert).
III. Eye Wounds in Mountain Warfare (Dr. A. Loewenstein).
IV. Direct and Indirect Effects and Mechanics of War Wounds by Modern Infantry Projectiles and Shrapnel Bullets (Prof. C. Adam).
V. Direct and Indirect Wounds of the Eye by Explosive Shells, Including Wind Contusion and Burial under Earth Slides (Prof. B. Fleischer).
VI. Wartime Injuries of the Eye by Chemical Means, Burns and Gassing (Prof. A. Jess).
VII. Prevention of Sympathetic Ophthalmia in War; Excision and Exenteration (Prof. F. Schieck).
VIII. On the Occurrence of Contagious Inflammation of the Eye in the Field (Prof. P. Romer).
IX. Hemeralopia in the Field (Prof. A. Birch-Hirschfeld).
X. Eye Diseases Incident to General Diseases in the Field (Prof. M. Bartels).
XI. Psychogenic and Functional Eye Disorders in the Field (Prof. H. Oloff).
XII. War Blindness and the Care of Blind Soldiers (Prof. E. Krückmann).

XIII. On Spectacles for Riflemen (Prof. A. Brückner).
XIV. Protective Spectacles and Devices for Protecting the Eyes in the Field (Prof. R. Greeff).
XV. On Dazzling of the Eyes in the Air Service (Prof. M. Zade).
XVI. On Optical Aids in Cases of Gunshot Wound (Prof. W. Stock).
XVII. Fitness for Duty, Especially in Relation to Acuity of Vision and Refraction, based upon Experiences in War (Dr. E. Watzold).

B. Special Section

I. Injuries of the Central Optic Paths incident to Gunshot Wounds of the Cranium (Prof. W. Uhthoff).
II. Choked Disk in Gunshot Wounds of the Brain (Prof. E. Von Hippel).
III. Disorders of the Musculature of the Eye in the Wounded (Prof. A. Bielschowsky).
IV. Injuries of the Eye from Foreign Bodies (Prof. E. Hertel).
V. Gunshot Injuries of the Temporal Part of the Orbit and Impacted Missiles (Prof. R. Cords).
VI. Plastic Operations on the Eyelids and Conjunctiva for Gunshot Injury (Prof. H. Kuhnt).
VII. Simultaneous Injuries of the Orbit and the Accessory Sinuses and Plastic Surgery of the Orbit (Prof. E. Krückmann).
VIII. On Artificial Eyes in Cases of Gunshot Injury (Prof. O. Schraudige).

VOL. 6.—WOUNDS AND DISEASES OF THE UPPER AIR PASSAGES AND DIGESTIVE TRACT AND OF THE EAR (Editors: Prof. Gustav Killian and Prof. Otto Voss), 300 pp.

A. Injuries of the Upper Air Passages and the Upper Digestive Tract

I. Injuries of the Nasal Cavities (Prof. O. Kahler).
II. Injuries of the Antrum (Prof. R. Hoffmann).
III. Gunshot Injuries of the Frontal Sinus, the Ethmoid Cells and the Sphenoidal Sinus (Dr. Max Weingaertner).
IV. Injuries of the Pharynx and Oesophagus (Prof. O. Kahler).
V. Gunshot Injuries of the Larynx (Prof. Gustav Killian).
VI. Injuries of the Nerves Supplying the Upper Air-Passages and the Upper Digestive Tract (Prof. H. Neumayer).
VII. Disorders of the Voice and of Speech in the Wounded (Prof. H. Gutzmann).

B. Diseases and Injuries of the Ear

I. Injuries of the Organ of Hearing: (*a*) of the External Ear, (*b*) of the Middle Ear, (*c*) of the Internal Ear (Prof. O. Fleischmann); (*d*) Diseases of the Central Paths of Audition and Equilibrium (Prof. O. Voss).
II. Damage Done to the Organ of Hearing through Explosions and Effects of Sound Waves (Prof. B. Oertel).
III. Diseases of the Ear in War: (*a*) Resulting from Wartime Epidemics, (*b*) Resulting from Non-infectious Processes, (*c*) Resulting from Gas Attacks, (*d*) In the Personnel of Airships and Aëroplanes (Prof. W. Lange and K. Grahe).
IV. Functional Injuries of the Organ of Hearing through the Effects of War (Prof. K. von Eicken).
V. Aggravation and Simulation of Disorders of Hearing in Soldiers in Campaign (Prof. P. Stenger).

VI. Reciprocal Relations of Old-Standing Ear Troubles and Gunshot Injuries of the Ear (Prof. H. Rhese).

VII. Preventive Measures against Impairment of Hearing in Soldiers: Curative Measures; Plastic Operations and Prothesis in Injuries of the Muscles of the Ear; Prothesis in Impairment of Hearing (Prof. P. Friedrich).

VOL. 7.—HYGIENE (Editors: Prof. W. Hoffmann and Prof. K. Kutscher), 500 pp.

A. General Section

I. Hygiene of Replacement Troops, Fitness for War Service, etc. (Prof. O. Martineck and Prof. E. Koschel).

II. Hygiene of Military Sheltering Places, Water Supply, Removal of Offal, etc. (Prof. W. Berghaus and Prof. M. Riemer).

B. Special Section

I. Nutrition (Dr. K. Kutscher).

II. Construction and Hygiene of Prison Camps (Prof. A. Gärtner and Prof. F. Konrich).

III. Measures for Sanitation on the Boundaries of the Empire (Prof. H. Hetsch).

IV. General Measures for the Prevention of Epidemics in Troops, including Disinfection, Bathing, Destruction of Vermin (Prof. W. von Drigalski and Prof. A. Hase).

V. (*a*) Typhoid Fever (Prof. Richard Pfeiffer), (*b*) Paratyphoid Infection (Prof. E. Hübener).

VI. Bacillary Dysentery (Prof. K. Boehncke).

VII. Cholera (Prof. W. Hoffmann).

VIII. Typhus Fever (Prof. R. Otto).

IX. Weil's Disease (Prof. P. Uhlenhuth and Prof. W. Fromme).

X. Malarial Fever, Five-day Fever, Relapsing Fever (Prof. F. von Wasielewski).

XI. Gas Edema (Dr. F. Klose).

XII. Influenza (Prof. B. Möllers).

XIII. Venereal Diseases (Prof. W. von Drigalski).

XIV. The Parasitic Diseases of the Skin (Prof. G. Arndt).

C. Appendix

Prevention of Gassing (Dr. W. Niehues).

VOL. 8.—PATHOLOGICAL ANATOMY (Editor: Prof. Ludwig Aschoff), 600 pp.

I. Pathological Processes not Characteristic of the War, but Influenced by it Severity and Extent of Incidence.

(*a*) Organic Diseases:

1. Relations of the Heart and Heart Disease (Dr. Th. Fahr).
2. The Vascular System and its Diseases (Prof. J. G. Mönckeberg).
3. Diseases of the Organs of Respiration and Digestion, and of the Nervous System (Prof. G. Herxheimer).
4. Diseases of the Kidneys (Prof. G. Herxheimer).
5. The Glands of Internal Secretion (Dr. H. Sternberg and Dr. Jaffé).
6. The Skin and Its Diseases (Dr. J. Kyrle).

(*b*) General Diseases:

1. Rudimentary Tumors (Dr. A. Weinert).
2. Tumors (Prof. D. von Hansemann).
3. General Considerations of Phthisical Infections (Dr. A. Weinert).
4. Progressive Phthisis (Prof. H. Beitzke).

5. Diseases from Exhaustion (Prof. O. Lubarsch).

II. Epidemic Diseases Peculiar to or Observed During the War:
- (*a*) Typhoid Fever (Dr. S. Gräff).
- (*b*) Paratyphoid Fever (Dr. R. Von Wiesner).
- (*c*) Dysentery (Prof. M. Löhlein).
- (*d*) Typhus Fever (Prof. E. Fraenkel and Dr. W. Ceeler).
- (*e*) Epidemic Cerebro-spinal Meningitis (Dr. G. Gruber).
- (*f*) Poliomyelitis (Prof. O. Meyer).
- (*g*) Influenza (Dr. Fahrig).
- (*h*) Weil's Disease (Prof. H. Beitzke).
- (*i*) Smallpox (Prof. K. Helly).
- (*k*) Relapsing Fever (Prof. Fr. Luksch).
- (*l*) Cholera (Prof. O. Stoerk).
- (*m*) Malarial Fever (Pappataci Fever) (Prof. H. Dürck).
- (*n*) Mixed Infection (Dysentery, Typhoid, etc.) (Prof. C. Sternberg).
- (*o*) General Considerations of Immunity Reactions (Prof. M. Askanazy).

III. The Direct Pathological Effects of War:
- (*a*) Direct Pathological Effects of Gunshot, Bayonet, Saber Wounds, etc.
  1. General Considerations on the Effects of Projectiles, Weapons, etc. Anatomy of Shock, Hemorrhage and Death from Hemorrhage. Fatty Embolism. Varied Powers of Resistance of the Tissues according to Physical Structure (Prof. M. Borst).
  2. Gunshot and Other Injuries of the Skin (Dr. W. Koch).
  3. Gunshot Injuries of the Bony Framework (including the Joints) and its Soft Parts (Muscles) Prof. E. Walkhoff and Prof. A. Schminke).
  4. Gunshot Injuries of the Peripheral Nervous System (Prof. W. Berblinger).
  5. Gunshot and Other Injuries of the Blood Vessels (Prof. M. B. Schmidt).
  6. Gunshot Injuries of the Cranial Cavity and Its Contents:
     - (*a*) Brain (Prof. G. Ricker).
     - (*b*) Meningitis (Prof. A. Ghon).
  7. Gunshot Injuries of the Spinal Canal and Its Contents:
     - (*a*) Recent Stages (Prof. G. Ricker).
     - (*b*) Older Stages (Prof. C. Benda).
  8. Gunshot Injuries, etc., of the Organs of the Neck (Prof. S. Oberndorfer).
  9. Gunshot Injuries of the Thoracic Organs (Prof. H. Merkel).
  10. Gunshot Injuries, etc., of the Abdominal and Pelvic Cavities (Prof. A. Dietrich).
- (*b*) Direct Pathological Effects of War from Grosser Physical Agencies: 1. From Precipitation from Aëroplanes. 2. From Earth-Slides. 3. From Atmospheric Pressure (Dr. H. Groll).
- (*c*) Direct Pathological Effects of Heat and Cold in War: 1. Burns. 2. Heatstroke. 3. Exposure to Cold. 4. Freezing of the Body (Prof. Ludwig Pick).
- (*d*) Direct Pathological Effects of Chemical Agencies in War. 1. Gas Poisoning (Dr. W. Koch). 2. Asphyxias of Peculiar Type (Prof. J. Miller).

IV. The Healing of War Injuries, Particularly of Wounds. Disturbances and Complications of Wound-healing.

(*a*) Delayed Healing by Wound Infection:
1. Tetanus. 2. Gas Edema. 3. Pus Infections (Prof. L. Aschoff).

(*b*) Complications by Secondary Infection of Other Organs:
1. Urinogenous Infection. 2. Bronchogenic Infection (Deglutition Pneumonia). 3. Enterogenous Infection (Thrush, etc.) (Prof. L. Aschoff).

(*c*) Other Complications, Particularly through Disorders of the Circulation:
1. Thrombosis. 2. Bedsores. 3. Gangrene. 4. Erosions of the Gastric Mucous Membrane (Prof. Robert Rossele).

VOL. 9.—RONTGENOLOGY (Editor: Prof. Rud Grashey), 450 pp.

A. Introductory Review (Prof. Rud Grashey)
B. Technical Portion

1. The Rontgen Apparatus Employed in the Field (Dr. W. Niehues).
2. Construction and Management of Röntgen Laboratories in the Field. Methods of Improvisation, Illumination, Photography, Localization of Foreign Bodies (Prof. Rud Grashey).

APPENDIX: STEREOSCOPY (Prof. A. Hasselwander)

(C) Medical Portion

I. Surgical Röntgen Diagnosis:
1. Diagnosis of Recent Injuries (Prof. Rud Grashey).
Appendix: (*a*) Dumdum Wounds (Prof. W. Niehues).
(*b*) Gasphlegmon (Prof. A. Burchard).
2. Diagnosis of Older Gunshot Injuries:
(*a*) Injuries of the Bones and Joints (Prof. A. Köhler).
(*b*) Injuries of the Skull (Prof. N. Guleke).
(*c*) Injuries of the Jaws (Dr. F. Hauptmeyer).
(*d*) Injuries of the Thoracic Organs (Prof. M. Deneke).
(*e*) Injuries of the Abdominal Organs (Dr. J. Groedal).
(*f*) Injuries of the Urinary Organs (Prof. L. Kielleuthner).
3. Diagnosis of Other Surgical Conditions in Soldiers (Prof. R. Grashey).

II. Röntgen Diagnosis in Internal Medicine:
1. Diagnosis of Diseases of the Heart and Blood Vessels in Soldiers (Dr. H. Zondek).
2. Diagnosis of Diseases of the Lungs in Soldiers (Dr. K. Kaestle).
3. Diagnosis of Diseases of the Digestive Organs in Soldiers:
(*a*) Observations in the Field (Dr. W. Alwens).
(*b*) Observations in the Home Territory (Dr. F. Groedel).

III. Röntgen Procedures in Neurology (Prof. H. Albers-Schonberg and Prof. A. Saenger).

IV. Röntgen Procedures in Oto-Rhino-Laryngology (Dr. A. Blau).

V. Röntgen-Therapy (Prof. K. Altmann).

ASSOCIATION NOTES

The following is the program of the meeting at New Orleans as arranged at present. It is possible that some minor changes may be made in it, but it is not believed that these will be many, and there may be none. It will be admitted that the program as printed promises much of interest to the members of The Association. We have promises of attendance of delegates from the following foreign countries: Belgium, Cuba, Canda, England and the Netherlands.

It is earnestly urged that members of The Association attending this meeting help make it as successful as the program deserves that it should be:

TENTATIVE PROGRAM, MEETING OF THE ASSOCIATION OF MILITARY SURGEONS OF THE UNITED STATES, NEW ORLEANS, LA., APRIL 22–24, 1920.

HEADQUARTERS, HOTEL GRUNEWALD

First Session, April 22, 9.00 a. m.

1. Address of the President.

Reports of Executive Council, Secretary-Treasurer, Committee on Arrangements, Literary Committee, Committee on Legislation, Boards of Award, Necrology Committe.

Appointment of Nominating Committee, Auditing Committee, Committee on Resolutions.

Consideration of Amendments to Constitution and By-laws.

Miscellaneous business.

2. Addresses:

"Emergency Measures in Malaria Control," Surgeon L. B. Frick, U. S. P. H. S.

(Subject to be announced later), Lieut. Col. Robert A. Strong, M. C., U. S. A.

Second Session, 2.00 p. m.

1. Addresses:

"The Training of the Enlisted Men of the Medical Department," Dr. Gustavus M. Blech.

"Some of the Lessons of the War Which Are Applicable to Civil Practice," Dr. John Smyth.

"Deficiency Disease, with Special Reference to Pellagra," Surgeon Jos. Goldberger, U. S. P., H. S.

Third Session, 8.00 p. m.

1. Motion Pictures (20 minutes), illustrating:

"Technique Used at the Pennsylvania Hospital in the Treatment of Infections and Infected Wounds with Dichloramine-T."

"The Carrel Technique in the Treatment of Infections of the Bones and Joints."

2. Addresses:

"Venereal Disease in the Dutch Army," Dr. J. P. Bijl, Dutch Army.

(Subject to be announced later), Dr. C. E. Verdier.

"Physiotheraphy at the U. S. Naval Hospital, New York, N. Y." Captains C. H.

T. Lowndes, F. E. McCullough, A. M. Fauntleroy, M. C., U. S. N., and Comdr. Wm. Seaman Bainbridge, M. C., U. S. N. R. F.

Fourth Session, Friday, April 23, 9.00 a. m.

1. Addresses:

"The Founding of This Association, and Its Founder, as I Knew Him.—An Anecdotal Sketch of Professor, Doctor Nicholas Senn," Dr. Horace M. Brown.

The Practical Aspect of Trachoma and Its Control. Surgeon John McMullen, U. S. P. H. S.

"Why a Sanitary Train?" A. A. Surg. Wilbur S. Conkling, U. S. P. H. S.

Fifth Session, 2.00 p. m.

1. Addresses:

"The Results of Wound Excision and Suture," Lieut. Col. Martin B. Tinker, M. R. C., U. S. A.

"Neurologic Service in Naval Hospitals," Lieut. Comdr. R. F. Sheehan, M. C., U. S. N.

"The Future of Psychiatry in the Army," Med. Dir. Thomas W. Salmon, Nat. Comm. for Mental Hygiene.

Sixth Session, 8.00 p. m.

1. Motion Pictures (20 minutes), illustrating:

"Appliances Used in Bone and Joint Injuries."

2. Addresses:

"Impressions Gathered from the Experiences in the Great War from the Surgery of the Vascular System," Maj. Rudolph Matas, M. C., U. S. A.

"Types of Motor Ambulances Observed Abroad," Capt. F. L. Pleadwell, M. C., U. S. N.

Seventh Session, 9.00 a. m., Saturday, April 24.

1. Report of Nominating Committee.
2. Election of Officers.
3. Addresses:

"Modern Military Medical and Surgical Reconstruction in Relation to Vocational Education of Discharged Compensable Disabled Soldiers," Col. Frank Billings, M. C., U. S. A.

(Subject to be announced later), Col. Wm. F. Snow, M. C., U. S. A.

4. Installation of Officers and Reports of Committees.

Unfinished business.

Adjournment.

COMMENT AND CRITICISM

THE TONSIL IN RELATION TO ARMY EFFICIENCY [1]

By Major HENRY HALL FORBES

Medical Reserve Corps, United States Army

To those who have come from civil life the question of man power or greatest efficiency is in a way a new problem which we must face and a new attitude which we must hold in our endeavor from the medical and hygienic side of war, to place every man in the front line F. L. D. In other words, we must study pathological conditions as they exist in a fighting man, in an active army. The loss of a working day is a serious menace to our efficiency, and especially is this so in the front line, where time and study have been expended in preparing the individual for a really technical job. Perfection is unattainable, and this fact is emphasized in the attempt to obtain perfection from the medical viewpoint. Delay at any stage is dangerous, from the landing on the coast, all the way to the front, the break in the chain often involving serious consequences. Disease and injury must ever be present in a mobile army, but to minimize their effects is a task set to the Medical Corps. The accusation of the tonsil, a useless organ in the body, as a menace to the efficiency of the Army appears at first glance to be drawing on our imagination or perhaps looking at the question through the eyes of the specialist. When I give you figures showing the actual loss in working days to our Army and Navy in peace times, you will be willing, I am sure, to give to the diseased tonsil the consideration it deserves. Quoting from memory from statistics furnished by the Bureau of Medicine, Washington, a few years ago, I found that for the previous ten years there has been a yearly loss of some 10,000 working days to the Army and either 15,000 or 16,000 to the Navy. This was the largest single cause next to gonorrhea.

The wardmaster [2] has given me the following figures which represent the E. E. N. & T. services of this hospital under care from April 17 to May 26, 1918. They represent a mixed service of 158 patients; of these 56 were cases of tonsillitis or one-third of his special service; days in hospital 281, or 6 days for every case. This, added to a day or two off duty before and after admission, increases the loss of working days. These figures bear me out in a further investigation of the sequel of the diseased tonsils. In addition we must take into consideration the fact that it is extremely difficult to state positively whether a tonsil is diseased or not. This point is illustrated by diphtheria car-

[1] Paper read before Clinical Society of Camp Hospital No. 26 St. Aigneaux, France, June, 1918.

[2] At that time the camp hospital, consisting of 426 beds, was the center of an active service, St. Aigneaux being a replacement center.

riers and is noted in bacterial growths from diseased follicles with cultures of various microörganisms to which medical observers trace many of the systemic toxic conditions.

The reports [3] received by me from various contagious hospitals show that ear complications, which added gravity in contagious diseases, were present in 98 per cent of the cases in which chronic hypertrophied tonsils or adenoids were found or demonstrable diseased tonsils were present. Vincent's angina shows marked tendency to attack the tonsil as well as the teeth among our troops, and I have no doubt that careful investigation will reveal many carriers of this disease in analogy to our diphtheritic carriers. The diseased lymphoid ring about the pharynx likewise acts as a carrier of the meningo cocci and forms an additional menace. To quote Coakley of New York: "It was extremely difficult to decide between the diseased and healthy tonsil; certainly not without a culture." What, then, must be our position in regard to the tonsil as encountered here in the midst of war, where every day of sickness means a serious loss in man power. I am told that a government order forbids the removal of tonsils unless diseased or sufficiently hypertrophied to obstruct breathing. Certainly we could not put a man with hypertrophied tonsils, who depends on the mouth for respiration, in the front line and expect him to wear a gas mask. As it is possible for the surgeon with comparative safety to remove the tonsil under a local anesthetic, and as the performance of this small operation requires at the most a week's absence of the patient from duty, there can be no doubt that we are justified in recommending such a course in all cases of:

1. Obstructed breathing due to tonsil hypertrophy.
2. History of previous attacks.
3. Bacteriologically diseased tonsils.
4. History of rheumatism, nephritis, heart lesions in connection with even a slight tonsil history. (Operation and cases.)

We publish the following letter and report at the request of the secretary, Medical Veterans of the World War, Col. F. F. Russell:

MEDICAL VETERANS OF THE WORLD WAR
OFFICE OF THE SECRETARY-TREASURER
ARMY MEDICAL SCHOOL, WASHINGTON, D. C.

THE EDITOR, *February 25, 1920.*
The Military Surgeon,

DEAR SIR:

If possible, will you consider the publication of the following letter, or so much of it as you deem suitable for your journal:

[3] Forbes: "Removal of Tonsil as a Prophylactic Measure." *New York State Journal of Medicine,* December, 1916.

"*To all physicians who served the Federal Government during the war:*

"An association of Medical Veterans of the World War was organized at Atlantic City, in June, 1919, at the time of the meeting of the American Medical Association, and a constitution and by-laws adopted. About 2,800 physicians have already joined, and all others who are eligible are invited to join the society.

"The constitution states that 'The Dominant Purpose of this Association Shall Be Patriotic Service. The objects of this association shall be: To prepare and preserve historical data concerning the medical history of the war; to cement the bonds of friendship formed in the service; to perpetuate the memory of our medical comrades who made the supreme sacrifice in this war; to provide opportunity for social intercourse and mutual improvement among its members; to do all in our power to make effective in civil life the medical lessons of the war, both for the betterment of the public health and in order that preparedness of the medical profession for possible war may be assured.'

"The organization of the society provides for state and local organizations wherever the members desire it, and in some states, such as Wisconsin, organization has already been effected.

"It is desired by the national association that those who are already members meet together in larger and smaller groups, at the first convenient opportunity, and effect a local organization with a chairman and secretary, and also at the next meeting of the state medical society that a place be provided on the program for the Medical Veterans.

"The organization of the society is based on democratic principles, and it is hoped that the members who have already joined will take the initiative and organize their own state and local societies.

"The national organization will assist by furnishing application blanks and copies of the constitution and by-laws, and if desired, stationery.

"The first things to be done after the organization of a state society is effected is to elect a councillor to the general council of the organization, to represent the state society at the next annual meeting of the Veterans at New Orleans on the first day of the meeting of the American Medical Association, April 26, 1920.

"A badge or button for members of the society is being made and will soon be ready for distribution."

Yours very sincerely,

F. F. Russell, *Secretary.*

March 1, 1920.

To the President and Trustees of the Medical Veterans of the World War:

I beg to submit the following report for the month of February, 1920:

New members who joined during the month..... 169

This makes the total membership 2,711, divided as follows:

1. Medical Corps, U. S. Army.....	1,245
2. Medical Corps, U. S. Navy.....	51
3. U. S. Public Health Service.....	62
4. Contract Surgeons, Army.....	88
5. Acting Asst. Surgeon, U. S. P. H. S.....	47
6. Member, Local Boards.....	527
7. Medical Examiner, Local Board.....	183
8. Member Medical Advisory Board.....	508
	2,711

Last month the number of new members was	143
Dues paid in advance for second year	4
Circular letters were sent to 1,059 eligible physicians.	
Receipts for dues sent to	173
Bills mailed to	13
Letters returned because of defective addresses	18
Application blanks mailed in reply to requests	10

F. F. Russell,
Secretary.

We publish the following at the request of the Denver Anti-Tuberculous Society:

WHY TUBERCULOUS PERSONS WITHOUT FUNDS SHOULD NOT LEAVE THEIR HOME STATES

It is a reliably estimated that several hundred tuberculous persons without funds come to Denver every year. Practically all of them come because they have the mistaken idea that climate will cure tuberculosis.

They arrive, almost penniless, without having made any inquiries or any provisions for their needs. Since Colorado has no state, and Denver no municipal tuberculosis sanatorium (merely a ward at the County Hospital for thirty-five very sick tuberculous residents), the care of such indigent persons is limited to a few free private sanatoria, which are continuously so overtaxed that admittance is a long and difficult matter. These sanatoria comprise the two Jewish, which accept only a small number of Gentiles; a tent colony of men with a capacity for seventy "down-and-outers;" and a small home for a dozen destitute tuberculous women.

These tuberculous poor who migrate to Denver, finding no place where they can be cared for, look for light work in order to maintain themselves and often their dependent families, but the demand for such work is far in excess of the supply. Driven to any work they can get, with neither friends nor care, anxious, homesick, hopeless, they rapidly grow worse, and usually soon die. They die for lack of proper rest, food, fresh air, and medical attention, those essentials of treatment which many of them could have had at home—or here with sufficient funds for two years' care. Without these essentials climate is of no avail. If it were, Denver would welcome these tragic health-seekers instead of urging them, for their own best chances, to stay at home.

Denver also urges that the states throughout the country plan definite programs to retain their indigent tuberculous, giving them effective treatment in state sanatoria or in their own homes.

The Denver Anti-Tuberculosis Society,
221 Coronado Building, Denver, Colorado.

We published the following at the request of the Officer in Charge of Recruiting Drive, War Department:

THE BENEFITS OF ARMY SERVICE

Regardless of his station in life or the educational advantages he may or may not have enjoyed, an enlistment in the Regular Army offers many advantages to every young man.

For success in life every man needs a foundation of sound physical health, neatness, character, reliability, initiative and willingness to as-

sume responsibility as a basis on which to apply his education or special training. The Army offers to every young man the opportunity to develop all these qualities to an unusual degree.

Without robust health, his physical limitations prevent him from applying his knowledge and ability to the full extent of his possibilities. Without the qualities of character, reliability, initiative and sense of responsibility he must fail in life, however highly he may be educated or how skillful he may be in his trade or profession. Unless he has education and the specialized training required for his chosen life work, all the energy and steadfastness in the world will not bring success.

The physical benefits of Army training are so well known since the World War that they need little emphasis. Nearly every one has a brother or a cousin or knows a "boy next door" who came back to find that he could no longer wear his pre-war civilian clothes. The wholesome outdoor life, regular exercise, good food and physical training had changed him—made another man of him.

The nature of his life and duties tends to develop the other qualities mentioned to a high degree. The first impressions of a recruit are calculated to foster his responsibility and reliability. He is required to keep his rifle and equipment always in perfect condition, his clothes neat and clean, and his particular portion of the barracks in perfect order.

As he progresses in instruction and experience his responsibilities increase, and he is constantly called on to a greater degree to exercise initiative and to carry out instructions with exactness. While still a private he is, during his period on guard, solely responsible for good order and the protection of government property. His orders as a sentinel must be obeyed by all persons in the military service, regardless of what their rank may be.

As he progresses through the grades of corporal and sergeant his responsibility for his squad and platoon constantly increases. In learning how to carry out orders he has learned how to give them and to see that what he requires is done. The sense of authority thus developed makes him a leader of men and one whose leadership is instinctively accepted by others.

Loyalty, responsibility and initiative are the principles on which all armies are founded. In few other occupations are these qualities developed in such a high degree. The army "graduate" is fitted by his training to take his place as a more useful citizen and a better American.

To the man who has been unable to complete his education or who wants special training along some particular line, the Army offers great opportunities. The slogan, "Earn While You Learn," has been widely used in connection with army educational and vocational training facilities and well expresses the chances offered to an ambitious young man.

Every post has well-organized schools for the teaching of common school branches, and high school subjects are given at all the principal posts. Several schools have been established in which the soldier is given an opportunity to prepare under West Point graduates for entrance to the United States Military Academy at West Point, and numerous appointments to the Academy are made from the ranks of the Army every year.

Opportunities are also offered for training in trades. By choosing some branch such as the Air Service, Ordnance, Tank Corps, Signal Corps, Field Artillery or Motor Transport Corps, the soldier can secure thorough training in almost any mechanical or electrical trade which he may select.

Ample time during the day, apart from his military duties, is given the soldier to pursue his studies in both educational and vocational subjects.

During the time he is thus fitting himself to be a more useful and productive citizen the soldier is well paid instead of being required to pay for his own education or to accept small wages as an apprentice. His monthly pay is not less than $30 a month in addition to all his clothes, board and other living expenses and medical attention. Few young men just starting out in life can show this amount clear at the end of the month after paying their living expenses and buying their clothes. Thirty dollars is the lowest rate and increases substantially with length of service and promotion.

"All work and no play" is no more the policy in the Army than it is elsewhere, and ample provision is made for the soldier's entertainment and amusement. All sorts of athletic games are encouraged and the necessary equipment supplied at government expense. Every post has its Service Club, open to every man without cost and provided with games and reading and lounging rooms. Club rooms are also maintained by most companies where similar facilities are provided within the barracks. Nearly all posts have their Liberty Theaters with regular motion-picture programs and frequent plays by both amateur and professional talent.

To sum up, the Army offers a man an unusual opportunity for physical improvement and the development of those general qualities which make for good citizenship and success in life. If he wants more education or desires training in some special subject or trade, he has full opportunity to obtain them. During this time he is well cared for, generously paid, and not only allowed but encouraged to indulge in interesting and wholesome amusements. His life is well balanced, and at the expiration of his enlistment he is well fitted to take his place as a better and more useful member of society.

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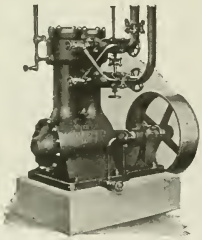

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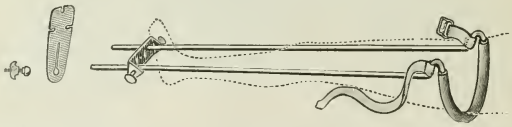

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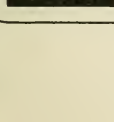
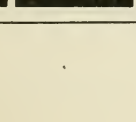
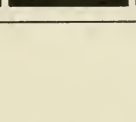
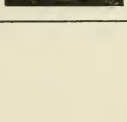
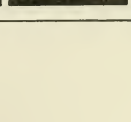
Fig. 1—Seamless Pails, sizes 8½, 11, 12½ and 16 quarts.
Fig. 2—Pitcher, capacity 9 quarts.
Fig. 3—Seamless Pitchers, sizes 1½, 1¾, 2½, 3½ and 6 quarts.
Fig. 4—Pitcher, capacity 2 quarts.
Fig. 5—Dressing Jars, sizes ½, 1, 2, 3¼ and 4 quarts.
Fig. 6—Irrigators, sizes 1, 2 and 3 quarts.
Fig. 7—Irrigators, sizes 1, 2 and 3 quarts.
Fig. 8—Funnels, diameter top, 3⅛, 4¾ and 6¼ inches.
Fig. 9—Oval Seamless Tubs, sizes 11 and 16 quarts—17 and 19 in. long.
Fig. 10—Conical Mugs, sizes top, dia. 2¾, 3⅛ and 3½ in.
Fig. 11—Conical Tumblers, sizes top, dia. 2¾, 3⅛ and 3½ in.
Fig. 12—Dinner Plates, sizes dia. 7⅛, 7⅞, 8⅝, 9¼ and 10½ in.
Fig. 13—Soap Dish with Drainer, size 5⅜ x 4⅛ x 1⅛ in.
Fig. 14—Cups and Saucers, sizes, cups ½ and ¾ pints; saucers 6⅛ in. dia.
Fig. 15—Sputum Cup, size 3⅞ x 3¾ in.
Fig. 16—Oval Trays, sizes 10 x 8 x ¾ in., 12 x 9½ x 13/16 in., 14 x 11¼ x ⅞ in., 16 x 13 x 15/16 in., 18 x 14 x 1 in., and 20 x 15 x 1⅛ in.
Fig. 17—Round Medicine Trays, sizes dia. 8, 10 and 12 in.
Fig. 18—Oblong Serving Trays, sizes 8⅜ x 11¼ and 11¼ x 16¼ in.
Fig. 19—Pus Pans, Kidney Shape, sizes 6¾ x 3 x 1¼, 8 x 3½ x 1½, 10 x 5 x 1¾ and 12 x 7 x 2 in.
Fig. 20—Basins, size 10⅜ x 2¾, 11¼ x 2¾, 11⅞ x 3⅛, 12½ x 3⅜, 13¾ x 3¾, 15 x 4, 15⅜ x 4½, 17¾ x 4½ and 19¾ x 5 in.
Fig. 21—Brush or Instrument Tray, size 8 x 3 x 1½ in.
Fig. 22—Eating Bowls, sizes 4 x 2⅝, 4¾ x 2¾, 5½ x 3 and 6¼ x 3¼ in.
Fig. 23—Sponge Bowls, sizes dia. by depth: 4 x 2, 5 x 2¼, 6 x 2¾ in.
Fig. 24—Bed Pan, 18½ in. long by 4 in. deep.
Fig. 25—Queen Bed Pan, 15 in. long over all, 12 in. wide over all, 4 in. deep over all.
Fig. 26—Instrument Trays, sizes 7⅛ x 5⅝ x 1⅛, 8 x 6 x 1¼, 9½ x 7½ x 1⅜, 16⅝ x 10¾ x 2⅜ in.
Fig. 27—Solution and Immersion Bowls, sizes 7 x 3, 8¾ x 3¼, 10¼ x 3¾, 11¾ x 4½, 12½ x 4½, 13½ x 4¾, 14¼ x 5, 15¾ x 5¾ and 17¾ x 6½ in.
Fig. 28—Ceylon Tea Pots, Individual, sizes 1½, 2 and 3 pints.
Fig. 29—Cuspidor, 7 in. dia. by 4 in. high.
Fig. 30—Cream Pitchers, capacity ½ pint.
Fig. 31—Male Urinal, seamed, capacity 1 quart.
Fig. 32—Female Urinal, seamed, capacity 1 quart.
Fig. 33—Bed or Douche Pans, Seamless, size 15¾ x 11¾ x 3 in.

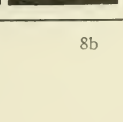












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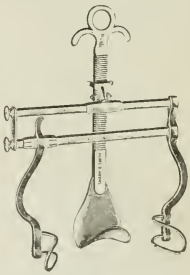

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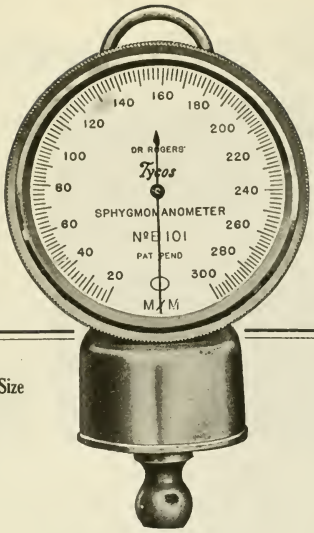

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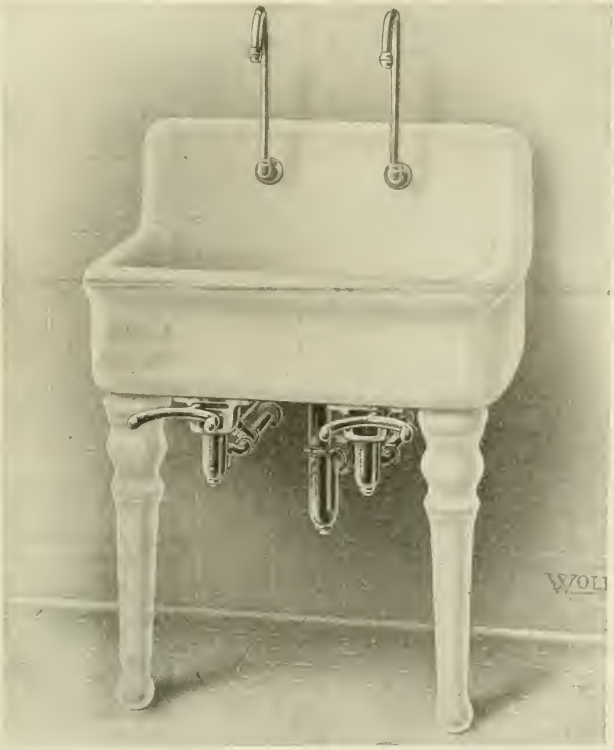

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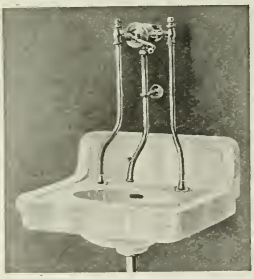

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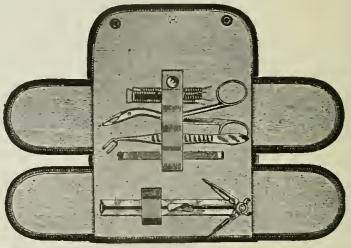

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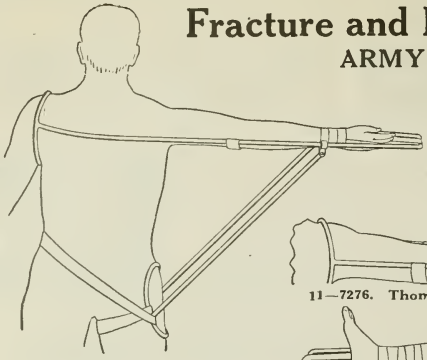

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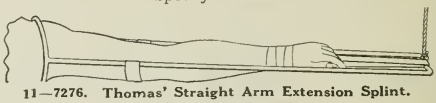

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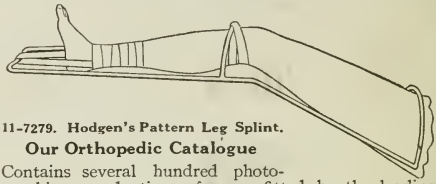

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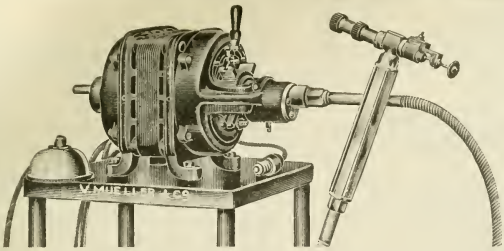

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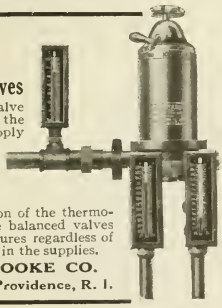

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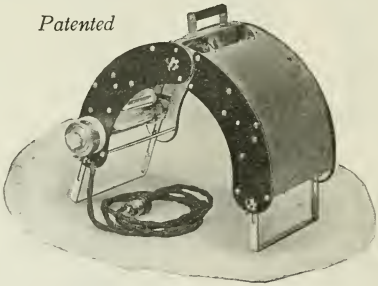

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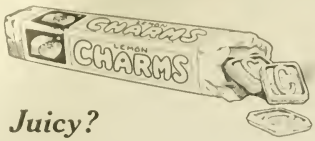

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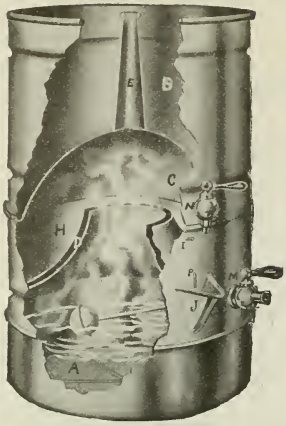

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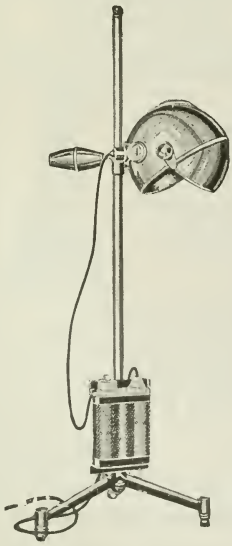

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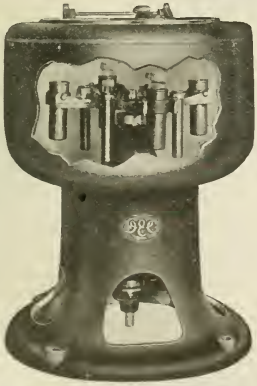

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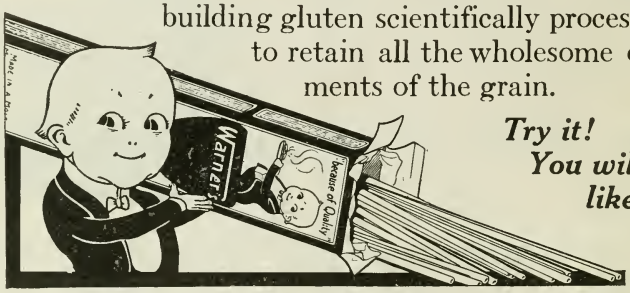

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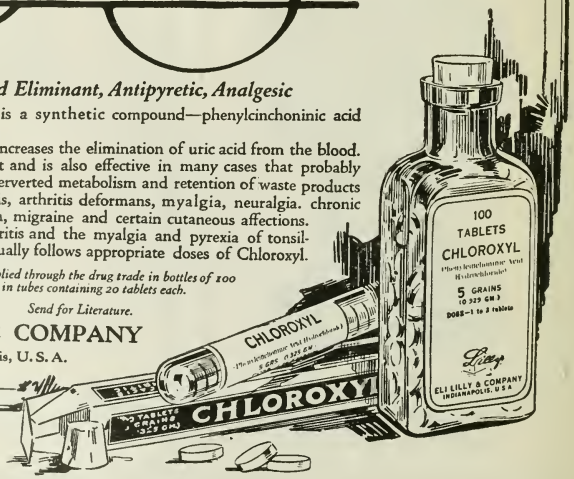

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